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BRIEF HISTORICAL OVERVIEW OF ARGENTINIAN PALEONTOLOGY: NATURALISTS, COLLECTIONS, AND INSTITUTIONS BETWEEN THE XVIII AND XX CENTURIES

Editors: Juan Carlos Fernicola, Carola Castiñeira Latorre, and Darío Lazo

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PROLOGUE

BRIEF HISTORICAL OVERVIEW OF ARGENTINIAN PALEONTOLOGY: NATURALISTS, COLLECTIONS, AND INSTITUTIONS BETWEEN THE XVIII AND XX CENTURIES

This thematic volume brings together fragments of the history of Argentine paleontology through the words of its current protagonists. Some of these works were initially presented at the XII Congress of the Argentine Paleontological Association (CAPA), held virtually in 2021. As in previous editions, CAPA 2021 aimed to communicate the latest scientific advances in the field, strengthen professional relationships among colleagues, and promote initiatives addressing gender inequality, protecting paleontological heritage, and disseminating knowledge about Earth history.

The congress occurred during an extraordinary and challenging time in recent human history: the global health crisis caused by the COVID-19 pandemic. During this turbulent context, the participants felt an urgent need to document and share historical and contemporary knowledge about the origin, diversity, and evolution of life. This endeavor was seen as a way to inspire continued advancements in understanding the history of life on Earth.

In this sense, the conception of this volume was driven by the desire to highlight some of the key milestones in the history of paleontology in Argentina and the surrounding region. It seeks to honor the contributions of prominent figures in that history and underscore the importance of collections as iconic resources that have shaped the discipline's identity. This compilation of works aims to share the history of a long-standing discipline in Argentina with colleagues worldwide and emphasize the significant role of South America in discovering new and relevant fossil remains.

The articles in this volume are organized into two chronological segments. The first explores the contribution of the individuals who, during the 17th, 18th, 19th, and early 20th centuries, advanced knowledge of the unique fossil record preserved in this part of the planet. The second focuses on studies related to the genesis of paleontological collections, which materialized these unique discoveries and now serve as global reference points for reconstructing the history of life on Earth.

This volume begins with the study by E. G. Ottone, whose narrative transports us to the origins of paleobotany in Argentina. The author highlights the contributions of Jesuits, European naturalists, and explorers who lived in and traveled through these lands in the 17th century. Figures such as Alonso de Ovalle, Antonii Sepp, Alcide d'Orbigny, and Charles Darwin are identified as the earliest contributors to the understanding of fossil plant records.

In the historical progression, during the second half of the 19th century, Argentine paleobotany was enriched by the descriptive and illustrative contributions of Hans Bruno Geinitz, Ladislaus (Wladyslaw) Szajnocha, and Fritz Kurtz. By the 20th century, as Ottone emphasizes, paleobotany had become firmly established as a specialized branch of paleontology in Argentina.

In the following chapter, J. C. Fernicola and C. Castiñeira Latorre revisit the legacy of early naturalists in the region's paleontology history. They contextualize the systematic framework developed by D. A. Larrañaga in his characterization of the armored *Megatherium*, acknowledging him as a pioneer of vertebrate paleontology in the Río de la Plata region. Their analysis highlights the inclusion of Larrañaga's note in the second edition of Georges Cuvier's work, *Recherches sur les ossemens fossiles de quadrupèdes*, published in 1823 as evidence of Larrañaga's expertise in taxonomy, classification, anatomy, and stratigraphy, as well as the international recognition of his contributions.

In the next chapter, M. Bond anchors the origins of Argentine paleontology in the contributions of J. Muñiz and highlights the scientific and administrative achievements of the German scholar Hermann Burmeister. Bond introduces

key figures in scientific history, including Florentino and Carlos Ameghino, Alcides Mercerat, Santiago Roth, Richard Lydekker, William B. Scott, and Lucas Kraglievich. Through their knowledge and actions, these individuals played pivotal roles in the founding of emblematic institutions, such as the Museo Público de Buenos Aires (currently known as Museo Argentino de Ciencias Naturales "Bernardino Rivadavia)" and the Museo de La Plata.

This first set of articles concludes with the work of A. Riccardi, who invites us to recognize the figures and events that shaped invertebrate paleontology in Argentina. The author highlights, within this configuration, the formation of the first collections and the foundational publications of d'Orbigny and Darwin, Forbes and Sowerby, followed by those of Stelzner, Bodenbender, and the studies of Kayser, Gottsche, Behrendsen, Tornquist, and Steuer. The author recreates early scientific expeditions' contributions to Patagonia, culminating with Harrington's establishment of the first national paleontological school. Riccardi's article serves as a prelude to this volume's second set of studies, hinting at the critical role that collections have played in the history of paleontological knowledge.

The second section of the volume, which explores the history of Argentine paleontological collections, opens with the work of C. Castiñeira Latorre and J. C. Fernicola. Their study examines the formation of one of the most significant collections for understanding and debating the antiquity of humanity in the Río de la Plata basin. These authors focus their analysis on the catalog of materials compiled by Florentino Ameghino for exhibition at the *Exposition Universelle* in Paris in 1878. This catalog is a link and reference point for developing Ameghino's scientific ideas and innovative classification system. Ameghino's classifications—distinguishing between the natural or anthropic origin of the objects in his collection and assigning them a temporal order—serve as benchmarks for critically examining the relevance of current curatorial criteria.

In the life history of collections, episodes of emergence and splendor are revisited alongside moments of displacement, neglect, and renewed appreciation. Some of these episodes are recounted by L. E. Cruz and J. C. Fernicola, who document the journey of the glyptodont fossils recovered in Paraná by Lelong Thévenet. These fossils and other vertebrate specimens were acquired through H. Burmeister and are now housed at the Museo Argentino de Ciencias Naturales. Several specimens from the informally named «Lelong Collection,» including type specimens, have been recently located and subsequently highlighted in paleontological research.

Similarly, the work of M. Reguero and collaborators report on new curatorial efforts aimed to recover and showcase one of the earliest collections of fossil vertebrates incorporated into the Museo de La Plata in 1887. The authors emphasize the achievements in organizing these historic collections, a challenge that continues to be central to contemporary museum management.

Within the realm of paleobotanical records preserved in museums, J. Bodnar and collaborators underscore the significance of the paleobotanical collections at the Museo de La Plata. These collections, internationally recognized, particularly for their contribution to understanding Gondwana's flora, originated from S. Roth's fieldwork and were enriched by the donation of J. Frenguelli's private collection. These records were preserved and strengthened through the stewardship of S. Archangelsky, who integrated the collection into the university's educational framework, establishing a positive feedback loop that significantly and continuously expanded macroscopic and microscopic collections through the early 21st century.

Returning to the origins of vertebrate fossil collections and the interaction between museology and academia, P. Ortiz and collaborators contextualize the formation of the collection at the Facultad de Ciencias Naturales–Instituto Miguel Lillo, Universidad Nacional de Tucumán. This collection, one of the most important in Argentina, originated from materials collected by Abel Peirano in Catamarca and Tucumán provinces during the late 1930s. However, it was not until 1957 that the collection was formalized, thanks to the efforts of paleontologist and evolutionist Osvaldo Reig. From that point onward, South American Mesozoic fauna specimens grew significantly, advancing scientific knowledge through numerous national and international publications.

The collection was further consolidated with the contributions of paleontologists such as J. Bonaparte and J.

Powell, along with others whose careers were shaped under their mentorship. Among the notable figures in the history of Argentina's paleontological collections, S. de Devincenci and E. Cerdeño document the collection initiated by naturalist C. Rusconi, which now enhances the Museo de Historia Natural de Mendoza. Rusconi collaborated with leading paleontologists affiliated with the Museo Argentino de Ciencias Naturales, including C. Ameghino, L. Kraglievich, A. Castellanos, and L. Parodi. Throughout his career, Rusconi developed a significant paleontological collection, primarily from Mendoza and other areas of the Cuyo region. He organized the museum, inventoried and catalogued specimens, and published numerous articles on Paleozoic trilobites and graptolites, Jurassic marine reptiles, and Triassic fish and amphibians. The type specimens from this collection have led to the identification of numerous new taxa. Rusconi's commitment to preserving historical records also motivated his advocacy for legislation to protect Mendoza's paleontological and archaeological sites, though he did not live to see this effort succeed.

This volume concludes by documenting the history of a collection that has been highly influential in understanding vertebrate evolution in the Southern Hemisphere. M. Reguero and collaborators highlight the importance of the global Antarctic fossil vertebrate collection, the largest of its kind, housed at the División Paleontología de Vertebrados of the Museo de La Plata. With nearly 32,000 specimens, including fishes, frogs, marine reptiles (plesiosaurs and mosasaurs), avian and non-avian dinosaurs, turtles, and marine and terrestrial mammals, the collection holds 22 holotypes and numerous well-preserved skeletons. Institutional highlights include icon specimens like the elasmosaurid plesiosaur *Vegasaurus*, non-avian dinosaurs like *Antarctopelta* and *Trinisaura*, and avian dinosaurs like *Vegavis* and *Conflicto*.

Through the efforts of contemporary scholars, this volume invites readers to explore fragments of paleontological history where renowned figures and iconic specimens bear witness to the greatness and significance of science in southern South America. Special thanks are extended to the *PE-APA* editorial team for their support in publishing this volume and, by extension, to the A.P.A. committee for their commitment to promoting paleontology in Argentina.

Juan Carlos Fernicola, Carola Castiñeira Latorre, and Darío Lazo
Editors

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ASOCIACIÓN PALEONTOLÓGICA ARGENTINA

ON THE TRAIL OF JESUITS, EXPLORERS, AND SCIENTISTS: A HISTORY OF PALEOBOTANY IN ARGENTINA

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Abstract. Jesuits such as Alonso de Ovalle and Antonii Sepp, naturalists-explorers such as Alcide d'Orbigny and Charles Darwin, and scientists such as Alfred Wilhelm Stelzner and Rudolf Zuber discovered and collected fossil plants from the 17th century onwards. The first descriptions and illustrations of material recovered in our country date back to the second half of the 19th century and correspond to European researchers such as Hans Bruno Geinitz, Ladislaus (Wladyslaw) Szajnocha, and Fritz Kurtz. Argentine paleobotany was born as a paleontology specialty in the 20th century.

Key words. History. Paleobotany. Argentina.

Resumen. TRAS LOS PASOS DE JESUITAS, EXPLORADORES Y CIENTÍFICOS: UNA HISTORIA DE LA PALEOBOTÁNICA EN LA ARGENTINA. Jesuitas como Alonso de Ovalle y Antonii Sepp, naturalistas-exploradores como Alcide d'Orbigny y Charles Darwin y científicos como Alfred Wilhelm Stelzner y Rudolf Zuber, descubrieron y coleccionaron plantas fósiles desde el siglo XVII en adelante. Las primeras descripciones e ilustraciones de material recuperado en el país son de la segunda mitad del siglo XIX y corresponden a investigadores europeos como Hans Bruno Geinitz, Ladislaus (Wladyslaw) Szajnocha y Fritz Kurtz. La paleobotánica argentina surgió como una especialidad de la paleontología en el siglo XX.

Palabras clave. Historia. Paleobotánica. Argentina.

FOSSIL plants have been known in Europe since ancient times. For instance, in the 1st century, Pliny the Elder (23–79) in "*Natvralis Historiae*" referred to the presence of petrified wood. Then, in the 13th century Albert the Great (*ca.* 1200–1280) also mentioned plant petrifactions in "*The Mineralibus*" (Ottone, 2008a). In addition, the first illustrations of vegetal fossils date back to the 17th century (Wilding, 2005). Remarkably, the 17th and 18th centuries constituted a period of great changes in European science: leading institutions, such as the Accademia dei Lincei in Roma, the Jardin Royal des Plantes Médicinales in Paris—which became the Muséum National d'Histoire Naturelle during the French Revolution—, or the Royal Society of London, were founded in the 18th century. These cenacles were the framework to the Enlightenment, an intellectual movement that had science and humanism as principles and led to modern science's foundation. Moreover, the study of plant fossils was no stranger to this paradigm shift. Taxonomic works with descriptions, comparisons, and illustrations of fossil material began to be published during the first half of the 19th century. Seminal contributions by Kaspar Maria von Sternberg (1761–1838) or Adolphe Théodore Brongniart (1801–1876) account for this fact (Cleal *et al.*, 2005). Knowledge of fossils and particularly plants became relatively popular during that century. Interestingly, in literature Jules Verne's "*Voyage au centre de la Terre*" described the fantastic finding in the depths of the earth of "*la végétation de l'époque tertiaire dans toute sa magnificence. De grands palmiers, des espèces aujourd'hui disparues*" (the vegetation of the Tertiary Period in its fullest blaze of magnificence. Tall palms, belonging to species no longer living) (Verne, 2003, p. 260). This novel was published in 1864.

That very year, while children were reading about Cenozoic palms in France, President Bartolomé Mitre (1821–1906) ruled the Argentine Republic. This country had been recently unified after years of fratricide wars between the Unitarian and Federalist parties. Even though Jesuit priests in the 17th and 18th centuries and European explorers during the first half of the 19th century had accounted for

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the region's natural history, science itself had mostly been set aside in these lands. Notwithstanding, the Argentine government radically changed this state of affairs in the 1860s with the creation of the Departamento de Ciencias Exactas de la Universidad de Buenos Aires—devoted to the teaching of Pure and Applied Mathematics and Natural History (Ramos, 2016)—, the foundation of the Academia Nacional de Ciencias in Córdoba Province under the guidance of Hermann Burmeister (1807–1892) (Tognetti & Page, 2000), and the building and commissioning of the Museo de La Plata with the direction of Francisco Pascasio Moreno (1852–1919) (Fasano, 2002). Paleontology, particularly the study of fossil plants, would develop in these new institutions, projecting from then on to the rest of the country.

This contribution goes through the paleobotanical findings from the 17th to the 19th centuries and the first taxonomic studies of the late decades of the 19th century. The most important events related to the study of fossil plants and the institutionalization of teaching and research of Paleobotany in the country in the 20th century are also highlighted.

JESUITS

The Society of Jesus, created by Ignacio (Íñigo) de Loyola (1491–1556) in the first half of the 16th century, arrived in the Río de la Plata area at the beginning of the 17th century to spread the Catholic faith, developing, at the same time, an outstanding scientific activity. The Jesuits founded in northern Argentina, Bolivia, south of Brazil, and Paraguay what became known as 'the Jesuit Reductions', where hundreds of Guarani people and a few priests lived and worked until the society was suppressed all over the Spanish Empire in 1767 (Ottone, 2008a). The Jesuits produced a big *corpus* of texts that included historical data, ethnographic information, and description of the *gea*, flora, and fauna, having Ioseph de Acosta's "*Historia Natvral y Moral de las Indias*"—published in 1590—as a model.

The Chilean Alonso de Ovalle (1601–1651), in his "*Historica Relacion Del Reyno de Chile*", was the first author to refer to the presence of petrified wood in the Argentine territory. Ovalle (1646, p. 126) stated that the Paraná river "*conuierte en Piedra los ramos de los arboles, que caen dentro del, el gouernador Hernan darias natural del Paraguay Cauallero de grandes prendas, y fingular talento de gouierno, tenia en su casa un árbol entero, todo hecho de piedra, que sacaron del Rio*" (turns into stone tree branches that fall into it; governor Hernandarias, born in Paraguay, a gentleman of great intelligence and talented ruler, had in his home an entire tree, completely made of stone, which had been taken out of the river). This story about Hernando Arias de Saavedra (1564–1634), also known as Hernandarias, the first Native American to hold the office of governor of the Río de la Plata area and Paraguay towards the end of the 16th century, was introduced by Ovalle but also repeated by other Jesuits (Ottone, 2008a).

The French Nicholaus du Toit (1611–1680) in "*Historia Provinciae Paraquariae Sociatatis Jesv*" (du Toit, 1673), the Spanish Pedro Lozano (1697–1752) in "*Descripción Chorographica del Terreno, Rios, y Animales de las dilatadifsimas Provincias del gran Chaco, Gualamba*" (Lozano, 1733), José Guevara (1719–1806) in "*Historia de la Conquista*"—published in the 19th century—, José (Ioseph) Sánchez Labrador (1717–1798) in "*Paraguay Natural*"—still partially unpublished—, and the Austrian Martin Dobrizhoffer (1717–1791) in "*Historia de Abiponibus, Equestri, Bellicosaque Paraquariae Natione*" (Dobrizhoffer, 1784) wrote about the presence of petrified wood in the coast of the Paraná and Uruguay rivers. What is more, Gaspar Juares (1731–1804), born in Santiago del Estero Province, was another member of the Society who referred to the presence of vegetal petrifactions in the Río de la Plata but, unfortunately, his manuscripts have been lost (Furlong, 1954). Interestingly, Jesuits mostly believed, as Pliny the Elder and Albert the Great, that rivers could transform wood, but also bone, into stone (Ottone, 2008a, 2008b).

Another scholar who referred to the presence of several elements as flesh-like stones and fragments of logs in Argentine rivers was the Tyrolean Antonii Sepp (1655–1733), who published "*Reisebeschreibung wie dieselbe aus Hispanien in Paraquarian kommen*" with his colleague Anthonii Böhm. In Sepp & Böhm (1696, p. 171–172), he called his findings in the Uruguay river "*halb holz/ halb Stein*" (half wood/ half stone). Sepp stood out from the rest of the Jesuits because he had doubts in relating the origin of

petrifactions to the river water: "*Ob das Basser diese krafft oder wo diese Berånderung herkomme/ können wir nicht issen/ ift doch alles fehr curios zu fehen*" (Whether the water is responsible for this or where this change comes from/ we cannot say/ but it is all very curious to see). He located his findings near Salto Grande (Santa Fe Province), where a unit that is rich in fossil woods, the Pliocene Salto Chico Formation, crops out. Sepp's unearthing of petrified wood could be the first reliable record of plant fossils in the region (Ottone, 2008a).

ON THE EVE OF MAY

Besides the Jesuits, a few other authors referred to the presence of vegetal petrifactions in the Argentine territory before the displacement of the Spaniards from power in 1810. One example of this could be the English captain Woodes Rogers (*ca.* 1679–1732), the future governor of Bahamas, who cited in his 1708 memoirs Alonso de Ovalle's references on the power the Paraná's water had to petrify wood (Ottone, 2008a).

Similarly, Félix de Azara (1742–1821) traversed the eastern border of the Viceroyalty of the Río de la Plata between 1781 and 1801 as a negotiator in the territorial dispute between the Portuguese and the Spanish colonies. In his "*Voyages dans l'Amérique méridionale*", Azara (1809) mentioned petrified wood in the mouth of the Negro river on the Uruguay stream (Ottone, 2005). In this area, the Pleistocene El Palmar Formation, a unit rich in permineralized wood with silica, crops out (Ramos *et al.*, 2012).

Likewise, Luis de la Cruz (1768–1828) traveled from the Fuerte del Ballenar in Chile to Buenos Aires in 1806, looking for new and safe routes for crossing the Pampas. In his 1806 journal, this author (1835, p. 66) mentioned the presence of: "*árboles petrificados, aun estando en su misma situación*" (*in situ* petrified trees) near Rahuecó, *ca.* 15 km SE of Chos Malal, in Neuquén Province. The fossiliferous outcrops correspond to the Lower Cretaceous Mulichinco Formation (Aguirre-Urreta & Ramos, 2016). This finding constitutes the first *in situ* fossil plants discovered in the Argentine territory.

Notably, as well as the Jesuits, Rogers, Azara, and de la Cruz did not recognize petrifactions as fossil plants.

NATURALISTS-EXPLORERS

The second half of the 18th century and the beginning of the 19th was a time for the flourishing and institutionalization of the Natural Sciences, a period when exploration travels reached their peak. Naturalists-explorers trying to empirically describe the landscape and all natural objects they found, drastically changed the widespread idea that Europeans had about the Earth. For instance, the English expedition of Joseph Banks (1743–1820) and James Cook (1728–1779); the French expeditions of Philibert Commerson (1727–1773) and Louis Antoine Comte de Bougainville (1729–1811); the Spanish expedition of Alessandro Malaspina (1754–1810) and Taddeous Haenke (1761–1817) together with the voyages of Alexandre von Humboldt (1769–1859) and Aimé Bonpland (1773–1858); and in our country Alcide d'Orbigny (1802–1857) and Charles Darwin (1809–1882). These expeditions are capital milestones in this epic history.

D'Orbigny traveled as naturalist-explorer to South America between the years 1826 to 1833 with the support of the Muséum National d'Histoire Naturelle of Paris. He arrived in Argentina in 1827 and left the country in 1829. D'Orbigny (1835, p. 104) referred to the findings of Cenozoic fossil petrifactions at the banks of the Paraná river near La Bajada, now Paraná, in Entre Ríos Province: "*de gros tronçons de bois fossile, dont l'intérieur est agatisé; ce qui a fait croire aux habitans que le Parana, comme le dit Falconer, pétrifie les arbres qui tombent dans son lit; idée entièrement dénuée de fondement*" (of big pieces of fossil wood, whose interior is agatized, which made the inhabitants believe that the Paraná, as Falkner says, petrifies the trees which fall in its bed, an idea that is entirely unfounded). To clarify, the Jesuit Thomas Falkner (1702–1784) was the author of "A Description of Patagonia and the Adjoining Parts of South America", a book that had been published in 1774 in London.

D'Orbigny also referred to the presence of petrified wood in Cenozoic horizons from Cavallú Cuatiá, now La Paz, Entre Ríos Province, and northern Patagonia. D'Orbigny was thus the first author to recognize the fossil character of the petrified logs from Entre Ríos and Patagonia and to formally refer to the presence of fossil plants in Argentina (Ottone, 2005).

Darwin circumnavigated the world between 1831 and 1836 as a naturalist-explorer on the HMS Beagle commanded by Captain Robert Fitz Roy (1805–1865). He arrived in Argentina in 1833 and left the country in 1835. He mentioned silicified dicotyledonous wood in the Cenozoic of La Bajada and equivalent strata on the banks of the Uruguay river; coniferous and dicotyledonous wood in Cenozoic strata of the Santa Cruz river cliffs in Patagonia; and, finally, *in situ* gymnosperm silicified logs at Agua de la Zorra, near Uspallata, in Mendoza Province (Ottone, 2005, 2011). The latter, located in outcrops of the Triassic Paramillos Formation, is nowadays known as Darwin's Petrified Forest and is one of the most famous fossil localities of the country (Brea *et al.*, 2008, 2009). Fossil wood recovered by Darwin in Argentina was preliminarily classified by the botanist Robert Brown (1773–1858) in England (Lister, 2018).

ADVENTURERS AND SCIENTISTS

In the 19th century, a pleiad of European, but also American, adventurers and scientists traversed the Argentine territory, a land ravaged by the wars of independence and civil strife, and the territorial dispute against indigenous ethnicities. Most eventually returned to their countries, but a few became settlers and ended their days under the Southern Cross.

Among these was Bonpland, a French botanist and physician who accompanied von Humboldt on his scientific trip across tropical America between 1799 and 1804. In 1817 he moved to Buenos Aires. Then, in 1821 he was taken prisoner by Paraguayan troops while developing a farm in Misiones Province and forced to stay in the neighboring country for ten years. Later, he lived in Säo Borja, Brazil, and Santa Ana, Corrientes Province, where he finished his days in 1858. Bonpland collected petrified wood in Entre Ríos and the south of Corrientes and sent the material to the Muséum National d'Histoire Naturelle in Paris (Ottone, 2002, 2005).

It is worth mentioning in this context the activity developed by Woodbine Parish (1796–1882), the British ambassador at Buenos Aires from 1824 to 1832. He was an experienced politician but also deeply interested in natural sciences. In "Buenos Ayres and the Provinces of the Rio de La Plata", Parish gave a detailed description of the country and referred to the presence of petrified wood in the Uruguay river (Parish, 1852).

Likewise, Thomas Jefferson Page (1808–1899) was an American marine, engineer, and diplomatic who traveled around the country and Paraguay between 1853 and 1856 by orders of the United States government. He was received by President Justo José de Urquiza (1801–1870) and Manuel Taboada (1817–1871), the governor of Santiago del Estero Province. Page returned twice to the Río de la Plata region and left the country for good in 1858. In "La Plata, the Argentine Confederation and Paraguay" (Page, 1859), he mentioned the presence of petrified wood, probably Cenozoic in age, in Gualeguaychú, Entre Ríos Province (Ottone, 2011).

Similarly, Georges Claraz (1832–1930), a Swiss naturalist who arrived in the country with his colleague Jakob Christen Heusser (1826–1909) from Brazil to run a farm near Bahía Blanca in 1863. They later published in Europe the geological descriptions of Brazil and Argentina. In a diary of their trip to northern Patagonia, which remained unpublished during Claraz's lifetime, he referred to the presence of fossil wood, probably Late Cretaceous in age, in the central section of the Chubut river and near Maquinchao, Río Negro Province (Ottone, 2011).

Another of these explorers was Georges Chaworth Musters (1841–1879), an English officer of the British Army. In April 1869, he traveled from Punta Arenas, Chile, to Carmen de Patagones, reaching the south of Buenos Aires Province in May 1870. He mainly interacted with the Tehuelche tribe, but he also met with the last great Mapuche chief Valentín Sayhueque (*ca.* 1818–1903) in Neuquén Province. In "At home with the Patagonians" (Musters, 1871), he referred silicified wood in the sources of the Chico river, Santa Cruz Province (Ottone, 2005).

Also, the Italian Francesco Pietrobelli (1858–1916) came to Argentina in 1888 and was a pioneer in the Patagonia region, where he founded the Phoenix Patagonian Mining & Land Company. This enterprise promoted the opening of roads and the construction of the first buildings in what today is the city of Comodoro Rivadavia (Chubut Province). In his travel diary of 1897, he referred to the findings of great logs of *ca.* 6 m long near Tecka, Chubut Province (Ottone, 2011).

Finally, the American John Bell Hatcher (1861–1904) graduated from Yale in 1884 and worked with the famous paleontologist Othniel Charles Marsh (1831–1899). As curator of fossil vertebrates from Princeton, he traveled three times to Patagonia between 1869 and 1899. In his "Reports" (Hatcher, 1903), he recorded the presence of abundant fossil wood towards the headwaters of the Chico river, Santa Cruz Province (Ottone, 2011).

GOVERNMENT OFFICIALS AND MILITARY MEN

The defeat of the strong man of the country, Juan Manuel de Rosas (1793–1877), in 1852 led to a decade of political instability with two rulers struggling to overcome each other: the president of the Argentine Confederation Urquiza and the then governor of the Buenos Aires Province Mitre, who would later become the president of the country. The aftermath of the unification of the country by President Mitre in 1862 was marked by two military events: The War of the Triple Alliance against Paraguay, which finished in 1870, and the Conquest of the Desert campaign against the Indigenous people of the Pampas and northern Patagonia, which ended toward the mid-1880s. Vast territories from the Patagonia and Misiones regions were incorporated to the domain of the central government. Argentine presidents, well aware of the strategic importance of these areas, sent scientists to explore the territory. Meanwhile, the Sociedad Científica Argentina was created in 1872 and a few years later the Instituto Geográfico Argentino and the Sociedad Geográfica Argentina. In this context, military and government employees referred to fossil plants found in the country in books, letters or reports.

One of these was the French Victor Martin de Moussy (1810–1869), who settled in Argentina from 1841 to 1859 and worked for the government of Urquiza. In "*Description géographique et statistique de la Confédration Argentine*" (Martin de Moussy, 1860), he mentioned the presence of fossil wood near Concordia, Entre Ríos Province, in horizons referred to the Cenozoic (Ottone, 2005). On his return to France, President Mitre charged him with the representation of Argentina at the International Exposition of 1867 in Paris.

Interestingly, the catalogs of the exhibition in Paris were written by the English mining engineer Francis Ignacio Rickard (1837–1906) and some petrified trees discovered by Darwin in Paramillos de Uspallata, Mendoza Province, stand out among the material listed in these catalogs. Rickard had arrived in the country from Chile engaged by the then governor of San Juan Province, Domingo Faustino Sarmiento (1811–1888). Afterward, when Sarmiento was elected president in 1868, Rickard was appointed General Mine Inspector. In his 1868–1869 reports on mines, Rickard indirectly referred to plant fossils in the coal layers of the Andean foothills in the San Juan and La Rioja provinces (Ottone, 2011). Rickard also promoted the enactment of Act 8198, which established strong incentives for coal exploitation (Ottone, 2014). This new legal framework led to the exploration of coal-bearing strata and the discovery of fossil plants these horizons commonly yielded.

In turn, the Genoese engineer and topographer Nicola Grondona (1826–1878) surveyed Paso del Higo, Corrientes Province, a place which was in those days occupied by just a few families. Grondona's 1853 report to Governor Juan Pujol highlighted the beauty of the spot and its strategic emplacement near the Brazilian and Uruguayan borders, fostering the re-foundation of the village, today known as Monte Caseros. Grondona mentioned the presence of petrified wood in the area, probably Cenozoic in age (Ottone, 2011).

Another example is Benjamin Canard (1844–1903), who was born in Buenos Aires to a French father and an Argentine mother, studied pharmacy and law at the Universidad de Buenos Aires and participated as a pharmacist in the military health service during the War of the Triple Alliance. In his letters to a friend in Buenos Aires, which remained unpublished until 1972, he mentioned petrified wood at Ayuí Grande and Gualeguaicito, Entre Ríos Province, in an area of Cenozoic outcrops (Ottone, 2011).

Similarly, Franz Latzina (1845–1922), a Moravian mathematician, astronomer, and meteorologist who taught in Catamarca and Córdoba provinces, was appointed as head of the Oficina Nacional de Estadística in 1881. After that, he published a series of titles, among which his "*Geografía de la República Argentina*" stands out. In this book, he referred to Triassic fossil plants at Sierra de la Huerta, San Juan Province (Ottone, 2011).

Also, Francisco P. Moreno, a very important figure in Argentine social imagery (Fasano, 2002), should be mentioned. He was born in Buenos Aires and became a collector of fossils and natural artifacts from his early youth. He made several exploratory trips to Patagonia before being appointed Head of the Museo de La Plata in 1884. During one of his exploration journeys, he became a prisoner of the Indigenous people in Neuquén Province, escaping from captivity in a raft made from logs downstream the Limay river. In 1896, he led the Comisión de Límites entre la Argentina y Chile (Argentina-Chile Boundaries Commission), for what he is currently known as "*Perito* Moreno" in Argentina, as *perito* means "expert". Besides, he was a congressman and worked at the Ministerio de Educación. In his "*Viaje a la Patagonia Austral*" (Moreno, 1879), he mentioned petrified wood in the Cenozoic of Santa Cruz Province (Ottone, 2005).

In turn, Ramón Lista (1856–1897) studied in Europe and then in Argentina with the Head of the Museo Público de Buenos Aires, Hermann Burmeister (1807–1892). Lista was the governor of Santa Cruz Province between 1887 and 1892 and the author of books on Geography, Linguistics, and Natural Sciences. He mentioned the presence of Cenozoic petrified wood at El Gualichu, near Gastre, Chubut Province, in a note to the Revista de la Sociedad Geográfica Argentina in 1884 (Ottone, 2005).

Another significant name is Luis Jorge Fontana (1846–1920), a retired military man who became the first governor of Chubut Province in 1884. As Lista, Fontana had been born in Buenos Aires and studied Natural Sciences with Burmeister. He mentioned petrified wood in the immediacies of Colhue Huapi and Musters lakes, Chubut Province, in "*Viaje de Exploración en la Patagonia Austral*", published in 1886 (Ottone, 2005).

Notably, Sarmiento, as the governor of San Juan Province or the president of Argentina, advocated for the progress of education and the development of sciences. Among his numerous publications, "*Civilización i barbarie: vida de Juan Facundo Quiroga i aspecto físico, costumbres i abitos de la Republica Arjentina*" stands out. The book, published in 1845 while the author was exiled in Santiago de Chile, is currently known as "*Facundo*" and has become a seminal title in Argentine literature. In 1885, Sarmiento wrote a biography of the physician and paleontologist Francisco Javier Muñiz (1795–1871). He attributed to Muñiz the finding of petrified wood samples in the Pampas and compared them with those discovered by Darwin near Uspallata, Mendoza Province (Ottone, 2011).

In 1895, Moreno appointed Kaspar Jacob Roth (1850–1924) as head of the Paleontological Section of the Museo de La Plata. He had been born in Switzerland and arrived in Argentina in 1866. He also worked with Moreno in the Argentina-Chile Boundaries Commission. Roth referred to the presence of silicified wood in the horizons known as "*estratos con dinosaurios*" (strata with dinosaurs), which correspond to the Upper Cretaceous Neuquén Group (Ottone, 2011).

Other significant names worth mentioning are the Argentine Eduardo Aguirre (1857–1923), a professor of Geology and Mineralogy, the Spanish Miguel Puiggari (1827–1889), and the Scottish John Joseph Jolly Kyle (1838–1922)—the latter two were Chemistry professors—, who taught at the Facultad de Ciencias Exactas y Naturales, the school of sciences that was created in 1865 at the Universidad de Buenos Aires. Aguirre, seconded by his colleagues, published in the 1883 Anales de la Sociedad Científica Argentina, the study of Triassic coal from the Mendoza river and mentioned Stelzner's discoveries of fossil plants in equivalent horizons in Marayes, San Juan Province (Ottone, 2005).

Lastly, Manuel José Olascoaga (1835–1911) was the first governor of Neuquén Province and founder of the first capital of the territory, Chos Malal—placed in the confluence of the Neuquén and the Curileuvú rivers—. He published several texts on geography and maps, among which the mapping and description of northern Neuquén stands out. In 1908, he referred to the presence of great silicified logs on the banks of the Neuquén river, downstream Chos Malal, which probably correspond to the horizons of the Mulichinco Formation, discovered by Luis de la Cruz at the beginning of the 19th century (Ottone, 2011, 2014).

A GERMANIC SCHOOL OF SCIENCES

In 1862, Burmeister was appointed as director of the Museo Público de Buenos Aires, becoming an outstanding

figure in Argentine science. At this time, President Sarmiento, seconded by his minister of education and future President Nicolás Avellaneda (1837–1885), was carrying out a program to promote education at all levels. Then, in 1869, the central government asked Burmeister to reorganize the School of Sciences at the Universidad Nacional de Córdoba, for which he hired a selected group of German scientists. The Academia Nacional de Ciencias was founded in 1873 and, some years later, this institution began to publish the Boletín and the Actas de la Academia Nacional de Ciencias.

Burmeister had traveled across Argentina and Brazil between 1857 and 1860 with the support of his friend, the German geologist and naturalist von Humboldt. On his return to Germany in 1861, he published in Halle "*Reise durch die La Plata-Staaten*". Once back in Argentina, he published "*Description physique de la République Argentine*" in 1876. In this book, Burmeister mentioned the petrified *in situ* logs discovered by Darwin at Paramillos de Uspallata and fossil plants from several localities with Triassic outcrops, such as Casa de Piedra and Cacheuta, Mendoza Province, and Marayes, San Juan Province. He also mentioned the presence of petrified wood on the banks of the Uruguay river (Ottone, 2005).

Another important name to highlight is Alfred Wilhelm Stelzner (1840–1895), who was the first professor of Mineralogy at the Academia Nacional de Ciencias in 1871. Between 1872 and 1873, he collected fossil plants in the Carboniferous of Famatina, La Rioja Province, in the Triassic of Marayes, San Juan Province, and El Challao-Agua de la Zorra, Mendoza Province. Then, Hans Bruno Geinitz (1814–1900), a Mineralogy and Geology professor in Dresden, Germany, studied the material collected by Stelzner and published their description and illustration.

Classical fossil species, such as the Triassic *Thinnfeldia* (now *Dicroidium*) *crassinervis* from Marayes, and the Carboniferous *Otopteris* (now *Nothorhacopteris*) *argentinica* from Famatina, were described by Geinitz (1876). Geinitz's publication constitutes the first systematic study of fossil plants in Argentina (Ottone, 2005) (Fig. 1.2–3).

The second professor of Mineralogy at the Academia Nacional de Ciencias in 1874, and the second dean of the School of Sciences in 1880 was Ludwig Brackebusch. In 1875, Brackebush published the discovery of fossil plants in the Bajo de Véliz, San Luis Province, a Permian site that stands out by the fine preservation of its vegetal and invertebrate remains. A year later, when President Avellaneda visited the Academia on the inauguration of the

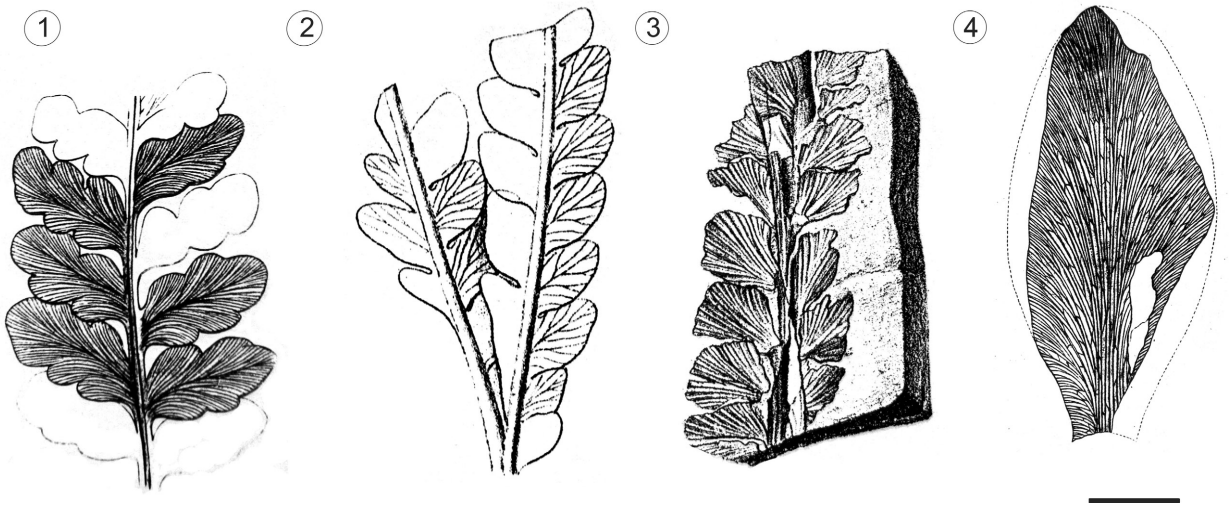

Figure 1.1, "*Neuropteridium validum*" Feistmantel, now ***Botrychiopsis plantiana*** (Carruthers) Archangelsky & Arrondo, in: Kurtz (1895b: pl. 1, fig. 2), Permian of Bajo de Véliz, San Luis Province; **2, "*Thinnfeldia crassinervis*"** Geinitz, now ***Dicroidium crassinervis*** (Geinitz) Anderson & Anderson, in: Geinitz (1876: pl. 1, fig. 13a), Triassic of Marayes, San Juan Province; **3, "*Otopteris Argentinica*"** Geinitz, now ***Nothorhacopteris argentinica*** (Geinitz) Archangelsky, in: Geinitz (1876: pl. 2, fig. 5), Carboniferous of Famatina, La Rioja Province; **4, "*Gangamopteris cyclopteroides*"** Feistmantel, now ***Gangamopteris*** sp., in: Kurtz (1895b: pl. 2, fig. 1), Permian of Bajo de Véliz, San Luis Province. Scale bar= 2 cm (**1**, **4**), 1 cm (**2**, **3**).

Córdoba-Tucumán railway, Brackebusch referred in a talk to the fossil plants horizons of the Carboniferous of Huaco and the Triassic of Marayes, San Juan Province. He also cited Stelzner's fossil findings in a report to the government of the Mendoza Province on the coal of La Reta in 1878 (Ottone, 2005, 2011, 2014).

In 1879, the Argentine army commanded by Julio Argentino Roca (1843–1914), who was Avellaneda's minister of war and the future president of the country, started the Conquest of the Desert campaign against the Indigenous peoples of the Pampas region. Roca and his troops reached the Negro river in northern Patagonia accompanied by priests and scientists associated to the Academia Nacional de Ciencias. The German Adolf Doering (1848–1925), who would later become a Chemistry professor at the Academia, was one of these men. In the 1882 Scientific Commission's official report, Doering cited the presence of petrified wood that had mostly been collected by Conrado Excelso Villegas (1841–1884) and Jorge J. Rhode (1854–1903), both high-ranking officers in the army commanded by Roca, in Upper Cretaceous or Cenozoic horizons at the proximities of Villa Roca, Río Negro Province (Ottone, 2005).

In addition, in 1884, Hugo Wilhelm Conwentz (1855–1922)—who had been born in Danzig, now Poland, and was in those days the head of the Westpreußischen Provinzialmuseum, an institution located in his hometown—, studied the material sent by Doering and published its description at the Boletín de la Academia de Ciencias. Cowentz's publication constitutes the first systematic study of fossil wood in Argentina (Ottone, 2005).

Moreover, Villegas—who was known as "*toro*" (bull) by the Indigenous people because of his strength and courage, and famous in the Pampas because of having the "*blancos de Villegas*" (a troop of white horses)—mentioned the presence of petrified wood in his book "*Espedición al Gran Lago Nahuel Huapí*" (Villegas, 1881). In the same way, Rhode mentioned his findings of vegetal petrifactions in "*Descripción de las Gobernaciones Nacionales de La Pampa, del Río Negro y del Neuquén*", a book published in 1889 (Ottone, 2011).

Another name worth mentioning is Rudolf Zuber (1858–1920), a Polish geologist who arrived in Argentina in 1886 to work in the oil industry in the Mendoza Province. He made the first geological map of the Cerro Cacheuta, a classical Triassic locality. Also, he recovered fossil plants from these strata and published his findings in the Boletín de la Academia Nacional de Ciencias in 1887 and in El Ingeniero Civil in 1888 (Ottone, 2005).

Then, Ladislaus (Wladyslaw in Polish) Szajnocha (1857–1928)—a Geology and Paleontology professor at the Universytet w Krakowie who was born in Lwowie (Austro-Hungarian Empire, now Poland)—studied the material collected by Zuber and published his work in Wien (Ottone, 2005). Szajnocha (1888, 1889) described two species of *Thinnfeldia* (now *Dicroidium*), *T. odontopteroides* and *T. lancifolia*, *Cardiopteris* (now *Zuberia*) *zuberi*, and *Sphenopteris elongata* (now *Xilopteris rigida*) and compared them to the Triassic fossil plants of Ipswich and Tivoli, Queensland, Australia.

The Triassic plant fossils described by Szajnocha were cited in 1889 by European scientists such as the Swedish Alfred Gabriel Nathorst (1850–1921) and the German Johann Heinrich Rudolf Schenck (1860–1927). The importance of fossils recovered at Cacheuta has had its echo among us. In this regard, the especial issue of January 1st 1890 of La Prensa, a journal published in Buenos Aires, also commented the findings (Ottone, 2005).

Sometime before this, in 1873, the Latvian Friedrich Wilhelm Karl Berg (1843–1902) arrived in the country invited by Burmeister. Then, following Burmeister's death in 1892, he became the second Head of the Museo Público de Buenos Aires and a Zoology professor at the Universidad de Buenos Aires. A priest from San Juan Province sent him plant fossils from the Carboniferous of Retamito and in 1891, Berg mentioned these fossils in two papers in the Anales de la Sociedad Científica Argentina (Berg 1981a, 1891b). Afterward, he sent the material to Szajnocha (1891), who determined the presence of Lycopsida and Equisetopsida remains.

Another significant scholar for our study is Hermann Avé-Lallemant (1835–1910), born in Lübeck, Germany. His father, Robert, was a physician who lived for several years in Brazil. Avé-Lallemant studied mining engineering in Europe and by the end of the 1860s he visited Argentina. In Buenos Aires, he met Burmeister and, under his influence,

he settled in the country, where he worked as a land surveyor and in the mining and oil industries. Avé-Lallemant mentioned the presence of Triassic fossil plants in El Challao and Cerro Blanco, Mendoza Province, and placed *in situ* fossil logs discovered by Darwin near Uspallata on a map for the first time in an 1891 paper in the Boletín de la Academia de Ciencias (Ottone, 2005).

Rudolf Hautal (1854–1928) was also born in Hamburg, Germany. He was a Botany and Geology professor at the Museo de La Plata and worked with Moreno in the Argentina-Chile Boundaries Commission. Hautal (1892) described and sketched a Triassic fossil fern leaf fragment recovered by Moreno at El Challao, Mendoza Province, in the Revista del Museo de La Plata. In 1898, he referred to fossil angiosperms in the Cenozoic of the Cerro Guido, Santa Cruz Province. Fritz Kurtz (1902) would study this material a few years later (Ottone, 2005).

Kurtz (1854–1920) was also born in Germany (Berlin). He obtained his Philosophischen Doctorwürde in 1879 in Berlin. In 1884, he replaced Georg Hieronymus (1845–1921) as a Botany professor at the Academia de Ciencias in Córdoba, holding this position until his retirement in 1915. Kurtz published five papers on Paleobotany in the 1890s. Among them, he described the genus *Botrychiopsis* and its type species, *B. weissiana*, which he published in the Revista del Museo de La Plata based on material from the Carboniferous of Retamito, San Juan Province (Kurtz, 1895a). Then, also in the Revista del Museo de La Plata, he carried out the first systematic study of the Permian flora of Bajo de Véliz, San Luis Province (Kurtz, 1895b) (Fig. 1.1 and 1.4). Much of his work remained unpublished and would become known after his death (Kurtz, 1921). The recent republication and careful revision of most of his articles (Kurtz, 1996; Archangelsky *et al.*, 1996) shows that Kurtz's work undoubtedly stands out from the rest of his contemporaries (Ottone, 2005).

Another German who would be important for these studies was Wilhelm Bodenbender (1857–1941), a geologist who studied at the Bergakademie Clausthal and at the Georg-August-Universität Göttingen. He arrived in Argentina in 1885 to replace Brackebusch as a Geology and Mineralogy professor in Córdoba. He also worked at the Servicio Geológico, Dirección de Minas, Geología e Hidrología de la Nación in Buenos Aires city. Bodenbender was mainly interested in studying the Precordillera and the Pampean mountain range. He mentioned fossil plants in the Carboniferous of Trapiche and Mina Retamito, San Juan Province and Paganzo, La Rioja Province; in the Permian of Bajo de Vé1iz, San Luis Province and Sierra de Los Llanos, La Rioja Province; and in the Triassic of Cacheuta, Mendoza Province. He also cited petrified wood in the probably Jurassic strata of Neuquén Province (Ottone, 2005, 2011).

Also, among this group of outstanding Germans for Argentine paleobotany was Jean Valentin (1867–1897), who was born in Frankfurt am Main and did his studies in Strasbourg. He traveled to Argentina and was involved with the Sociedad Científica Argentina and the Museo de Buenos Aires and Museo de La Plata. Unfortunately, his prolific activity was interrupted by his early death. He cited fossil plants recovered from the Carboniferous of Retamito, Cerro El Fuerte de Jáchal, and Trapiche, San Juan Province; the Permian of Bajo de Véliz, San Luis Province; and the Triassic of Challao, Paramillos de Uspallata, and Cacheuta, Mendoza Province and Marayes, San Juan Province (Ottone, 2011).

The importance of Argentine-reported findings of fossil plants, from Darwin to German scholars, was enhanced in the late 19th century by renowned foreign scientists such as the French René Charles Zeiller (1847–1915), a professor of the École de Mines of Paris, and the American Frank Lester Ward (1841–1913), a researcher of the United States Geological Survey (Ottone, 2005).

TIERRA DEL FUEGO

A 'Land of Fire' that haunted the imagination of navigators who approached its shores since the 16th century, the homeland of Selk'nam (Ona) and Haush hunters and Yamana and Alacaluf canoeists, Tierra del Fuego had been a scarcely explored territory before the foundation of Punta Arenas in 1848 and Ushuaia in 1884, at the place first occupied in 1869 by the Anglican mission station of the Patagonian Missionary Society. Tierra del Fuego was visited by the end of the 19th century by explorers and scientists, but also by adventurers who felt drawn by the discovery of placer gold deposits.

Among these was Giacomo Bove (1852–1887), an Italian naval officer who participated in the renowned Arctic

expedition of 1778–1880 commanded by Adolf Erik Nordenskjöld (1832–1901). He was called by the Argentine Government to lead an expedition to the southern seas. The expedition explored Tierra del Fuego and the Isla de los Estados between 1880 and 1881. In a preliminary report of results, the geologist in charge, Domenico Lovisato (1842–1916), referred to the findings of fossil plants by d'Orbigny in Patagonia and regretted the fact that he hadn't had the same luck in this regard (Ottone, 2011).

Another explorer who visited the island was Lulius Popper (1857–1893), a Romanian who studied engineering in Paris. After traveling around the world for several years, he arrived in Argentina in 1884 attracted by the gold rush. He exploited alluvial gold in El Páramo, north of San Sebastian Bay. Popper mentioned Cenozoic fossil logs of Fagaceae on the southern cliff of the Espíritu Santo Cape, Tierra del Fuego Province, Argentina (Ottone, 2005).

Then the last five years of the 19th century were marked by the arrival of the 1895–1897 Swedish Expedition at the Strait of Magellan, commanded by Otto Nordenskjöld (1869–1928). As a member of this expedition, Per Karl Hjalmar Dusén (1855–1926), a Swedish botanist who was originally a civil engineer, described and sketched a great number of fossil plants (mostly Fagaceae) recovered from the Sierra de Carmen Silva, Tierra del Fuego Province, and from southern Chile in "*Wissenschaftliche Ergebnisse der Swedischen Expetition*" in 1899 (Ottone, 2005).

A COUNTRY ON DISPLAY

In the second half of the 19th century, several European countries, the United States, and Argentina aspired to show their economic potential to the world, as well as spread their cultural legacy. In a world that increasingly became interconnected by sea, international exhibitions emerged as ideal meeting places for doing business and having cultural exchanges. Therefore, as part of the international exhibitions held in Paris in 1867, 1878, and 1889, in Philadelphia in 1875, the national exhibition of Córdoba in 1871, and the continental exhibition organized in 1871 by the Club Industrial Argentino at Buenos Aires, several publications were released, mainly catalogs of exhibits, which included fossil plants. The catalogs included references to fossil plants recovered from the Cenozoic strata of Corrientes and Entre Ríos, but also from San Juan and Santiago del Estero provinces. References to petrifactions in Sierra de la Huerta, San Juan Province, and fossil plant remains from the Triassic of Marayes, San Juan Province and El Challao, Mendoza Province, were also present. However, the site mentioned the most in different catalogs was undoubtedly the Triassic fossil forest discovered by Darwin in 1839 at Paramillos de Uspallata, Mendoza Province. 'Darwin's Petrified Forest' was an icon of Argentine heritage in 19th century international exhibitions (Ottone, 2011).

PATAGONIA REVISITED

In the first half of the 20th century, two authors made capital works on Paleobotany in Patagonia: The American Edward Wilber Berry (1875–1945) and the Italian Egidio Feruglio (1897–1954). Berry was a Paleontology Professor at John Hopkins University and also worked in the United States Geological Survey. He participated in different trips to the northwestern Andean region of South America collecting fossil plants (Reeside, 1945) and also studied material from Patagonia. He wrote about twenty—mostly systematic—papers on Cretaceous and Cenozoic taphofloras from Río Turbio, Santa Cruz Province; Pichileufú, Río Negro Province; and other Patagonian localities (Archangelsky *et al.*, 2000).

Yacimientos Petrolíferos Fiscales, known as YPF, was created in 1922 under the presidency of Hipólito Yrigoyen (1852–1933). The company's first director, Enrique Mosconi (1877–1940), promoted the exploration and discovery of new oil-producing wells. He provided YPF with the best laboratory equipment, staffed by highly qualified experts, and he hired renowned technicians and geologists to work in the field. Feruglio was one of them. Feruglio joined YPF in 1925, remaining inconsistently in the company until the 1940s. He produced around 60 works on Argentine Geology and Paleontology. His "*Descripción Geológica de la Patagonia*", in three tomes from 1949 to 1950, stands out as a foundational work in the region. Feruglio published several contributions on fossil ferns, ginkgophytes, and conifers (Archangelsky *et al.*, 2000; Spalletti, 2008). The Museo Paleontológico Egidio Feruglio in Trelew, Chubut Province, was named after him.

ACADEMICS AND SCHOLARS IN THE 20TH CENTURY

The 20th century was the moment for the definite institutionalization of science teaching in Argentina, focused on four institutions: The Instituto Miguel Lillo and the Universidad Nacional de Tucumán, the Museo and Universidad Nacional de La Plata, the Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, and the Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires. In 1958, the creation of the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), would tend to rule scientific activities until today in the country.

Some important leading figures from this period of time should be mentioned:

Miguel Lillo (1862–1931) was an Argentine naturalist and the author of "*Genera et Species Plantarum Argentinarum*", a comprehensive catalog of Argentine flora published after his death. The project of its publication was bolstered by a foundation named after him, which functioned in the Instituto Miguel Lillo, an institution created in 1933, closely linked to the Universidad Nacional de Tucumán (Lois, 2021).

Carlos Alberto O'Donell (1912–1954) was born in Buenos Aires. He moved to Tucumán after graduating as a pharmacist at the Universidad de Buenos Aires. He was the curator of the herbarium of the Instituto Miguel Lillo and taught Botany at the Universidad Nacional de Tucumán (Descole, 1954). O'Donell (1938) published a paper in the first issue of Cuadernos de Mineralogía y Geología which had the following title: "*Troncos y ramas fósiles de dicotiledóneas en el Araucaniano de Tiopunco (departamento de Tafí, provincia de Tucumán)*". Although O'Donell's analysis of fossil wood is schematic regarding current standards, this contribution stands out because it constitutes the first attempt by an Argentine to study fossil plants.

Sergio Archangelsky (1931–2022) was born in Casablanca, French Morocco, and graduated from Universidad de Buenos Aires. He was a professor in Tucumán from 1955 to the first years of the 1960s, beginning an outstanding career as a paleobotanist (Archangelsky, 2014). Archangelsky was undoubtedly the best paleobotanist of all time in Argentina (Archangelsky *et al.*, 2000).

Rafael Herbst (1936–2017) was the first graduate in Geology at the Universidad Nacional de Tucumán and the first graduate student under Archangelsky's tutorship. Herbst was born in Hannover, Germany, but, as his mentor, he lived in Argentina since childhood. Herbst taught Paleontology at the Universidad Nacional del Nordeste in Corrientes Province from 1967 until his retirement in 1998; following Archangelsky's footsteps, he was also an outstanding paleobotanist (Ottone, 2018).

Joaquim Frenguelli (1883–1958) was born in Rome, Italy, and got his medical degree in the same city. Invited by relatives, he traveled to Argentina in 1911 and worked as a physician in Santa Fe and Córdoba provinces. He was a professor at the Universidad Nacional del Litoral in 1920. In those years, he was concerned in the geology and geomorphology of northeastern Argentina and the study of silica microfossils, especially diatoms. He was the director of the Museo de La Plata between 1934 and 1946, and then again from 1953 to 1955. In his new position, he was devoted to Paleobotany, producing more than 30 papers on Paleozoic, Mesozoic, and Cenozoic fossil plants (Teruggi, 1986; Riccardi, 2013). Frenguelli's paleobotanical studies were continued by different scholars, such as Bruno Petriella, Oscar Arrondo, and Analía Artabe.

The teaching of Paleontology at the Universidad de Buenos Aires began in 1921 with the courses taught by Martín Doello Jurado (1884–1948) and after his death by Armando Federico Leanza (1919–1975) and Horacio Homero Camacho (1922–2015) (Aguirre-Urreta, 2016), who took his place. Although the teaching of Paleontology was then mainly focused on Invertebrate Paleontology, in those years a group of students felt interested in fossil plants because of the influence of Alfredo Castellanos (1893–1975), a former disciple of Kurtz and a Botany Professor at this university in the 1950s.

One who followed these inclinations was Pedro Stipanicic (1921–2008), a graduate student under the direction of Pablo Groeber (1885–1964), who was a Geology professor between 1933 and 1952 (Ramos, 2016). Stipanicic, together with his wife María Bonetti (deceased 2015), one of the first women devoted to Paleobotany in the country, worked in the Triassic of San Juan Province and made important contributions to the knowledge of this paleoflora (Archangelsky, 2009).

Castellanos influenced not only Stipanicic but also Archangelsky and paleobotanist Carlos Alberto Menéndez (1921–1976) (Archangelsky, 1970, 2009; Archangelsky *et al.*, 2000). Significantly, the latter would be the first Palynology Professor at the Universidad de Buenos Aires in the 1970s. Palynology, a new discipline to the country at the time, would progress at the institution from the 1980s led by former Menéndez's graduate student Carlos Azcuy, and then Archangelsky's doctoral student Edgardo Romero.

Moreover, Héctor Antonio Orlando, Frenguelli's graduate student at the Universidad Nacional de La Plata, published the first palynological work in the 1950s (Orlando, 1954). Nevertheless, it was in 1965 that Archangelsky, in co-authorship with Juan Carlos Gamerro (1923–2013), Herbst, and Menéndez, would begin to produce substantial contributions to the discipline according to current international standards (Archangelsky & Gamerro, 1965; Herbst, 1965; Menéndez, 1965a, 1965b).

Last but not least, Argentine women had a late arrival to Paleobotany in Argentina. The pioneer was María Bonetti. She was followed in the 1970s by Hetty Bertoldi (1924–2020), who studied phytoliths at the Universidad Nacional del Litoral, Alicia Baldoni and Analía Artabe at the Universidad Nacional de La Plata, and Josefina Durango at the Universidad Nacional de Tucumán, who studied the megascopic remains of fossil plants (Archangelsky *et al.*, 2000).

AN UNFINISHED STORY

Today, researchers in Argentina have innumerable resources to achieve their work: optical instruments, technical devices, and online specialized libraries are within reach. However, there are also economic problems, and the science budget falls short of what is required in the country. So, in this context, why write a history of Paleobotany?

History collects, analyzes, and puts events of the past in context. As a social science, but also deeply rooted in the humanities, history is "*cuando se escribe apasionadamente, una exegesis poética del tiempo*" (if passionately written, a poetic exegesis of time) (Lojo, 1987, p. 72).

The history of Paleobotany is an unfinished yarn that women and men weave daily. The story of a Jesuit priest going up the Uruguay river on a wooden boat, afraid of being attacked by a jaguar when—curious about a petrified log seen on the banks—he approached the coast. The tale of a young man traveling across a mountain range on the back of a mule, impressed to see a stone forest emerging to the sky from the hillside. A narrative depicting a woman in a dark room, her gaze caught by a scanning electron microscope scan, aware of the relationships between bracts and ovuliferous scales in a fossil cone. This is the history of Paleobotany, an unfinished yarn of searching, findings, and passion.

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ASOCIACIÓN PALEONTOLÓGICA ARGENTINA

DÁMASO ANTONIO LARRAÑAGA AND THE VERTEBRATE PALEONTOLOGY IN THE RÍO DE LA PLATA IN THE EARLY 19TH CENTURY

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Abstract. Dámaso Antonio Larrañaga was born in 1771 in Montevideo, a city that, by those years, integrated the territories of the Virreinato del Perú, and died in 1848 in the same city, current capital city of República Oriental del Uruguay. Until his death, the natural sciences played a fundamental role in his daily activities and were marked by his religious vocation and his participation in the complex struggle for the independence of South America and Uruguay. As a man of science, he studied botanical, geological, paleontological, zoological, linguistic, and ethnolinguistic topics, under different perspectives related to taxonomy, classification, anatomy, stratigraphy, herbalism, and native lexicography, among others. Parts of his work, manuscripts and drawings, were extensively published during the second decade of the 20th century. A small note of his authorship was included in the second edition of the work entitled *Recherches sur les ossemens fossiles de quadrupeds* by Georges Cuvier, published in 1823. Its content had a strong impact on the international scientific community because he included *Megatherium* as a subgenus of the armadillo *Dasypus*, postulating that this large mammal had an external armor. In this contribution, we analyze the work of Larrañaga and recreate the scientific context in which *Megatherium* was inscribed as an armored mammal. As a result, we intend to associate this inference in the diverse postulates concerning the classification of mammals, which, at that time, were based on dental structures, as well as the influence exerted by the interaction between prominent naturalists of the 19th century.

Key words. History. Armored *Megatherium*. Luján. Auguste de Saint-Hilaire. George Cuvier.

Resumen. DÁMASO ANTONIO LARRAÑAGA Y LA PALEONTOLOGÍA DE VERTEBRADOS EN EL RÍO DE LA PLATA A PRINCIPIOS DEL SIGLO XIX. Dámaso Antonio Larrañaga nació en 1771 en Montevideo, ciudad que en aquellos tiempos integraba los territorios del Virreinato del Perú, y falleció en 1848 en la misma ciudad, capital de la República Oriental del Uruguay. Hasta su deceso, las ciencias naturales ocuparon un rol fundamental en sus actividades cotidianas signadas por su vocación religiosa y su participación en la compleja lucha por la independencia de América del Sur y del Uruguay. Como hombre de ciencias, estudió temas botánicos, geológicos, paleontológicos, zoológicos, lingüísticos y etnolingüísticos, bajo distintas perspectivas relacionadas a la taxonomía, clasificación, anatomía, estratigrafía, herboristería, lexicografía nativa, entre otras. Parte de su obra, manuscritos y dibujos, fue publicada en extenso durante la segunda década del siglo XX. Una pequeña nota de su autoría fue incluida en la segunda edición de la obra *Recherches sur les ossemens fossiles de quadrupèdes* de Georges Cuvier publicada en 1823. Su contenido, tuvo un fuerte impacto en la comunidad científica internacional porque él incluyó al *Megatherium* como un subgénero del armadillo Dasypus y postuló que el gran mamífero presentaba una cobertura ósea externa. En este trabajo nosotros analizamos la obra de Larrañaga y recreamos el contexto científico en el que se inscribe al *Megatherium* como un mamífero acorazado. Apelamos entonces a asociar esta inferencia en los postulados para la clasificación de los mamíferos que, en aquellos tiempos, se basaban en las estructuras dentarias, así como también la influencia ejercida por la interacción entre destacados naturalistas del siglo XIX.

Palabras clave. Historia. *Megatherium* acorazado. Luján. Auguste de Saint-Hilaire. George Cuvier.

THE YEAR 2023 marks the 200th anniversary of the publication, in its second edition, of the famous work published by George Cuvier (1769–1832) *Recherches sur les ossemens fossiles de quadrupèdes*, including a brief scientific communication written by the Montevidean priest Dámaso A. Larrañaga (1771–1848) (Larrañaga, 1823a) (Figs. 1, 2). It was based on a letter that Larrañaga sent to the French naturalist Auguste de Saint-Hilaire (1779–1853) in 1822

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and presented at the Société Philomatique in Paris (Larrañaga, 1823b).

The content selected for publication in Cuvier's work revealed an interesting paleontological novelty offered in the following terms (Larrañaga, 1823a): "…*Je ne vous écris point sur mon* dasypus *(*mégatherium *Cuv.), parce que je me propose d'en faire l'objet d'un mémoire, qui, je l'espère, ne sera pas indigne de l'intperêt des savants Européens qui s'occupent des fossiles. Je vous dirai seulement que j'ai obtenu un fémur qui a été trouvé dans le Rio del Sauce, branche du Saulis-Grande. Il pèse environ sept livres et est court; il peut avoir six à huit pouces de large. Il ressemble en tous points à un fémur de Tatou. Je vous enverrai un de ses écailles. La queue qui, comme vous l'avez vu, est et très-courte et très-grosse, elle a également des écussons, mais ils ne sont point en forme d'anneaux ou de verticilles…*" (…I am not writing to you on my *dasypus* (*megatherium* Cuv.), because I intend to make it the subject of a memoir, which, I hope, will not be unworthy of the interest of the European sages who deal with fossils. I will only tell you that I obtained a femur which was found in Rio del Sauce, branch of Saulis-Grande. It is short, weighs about seven pounds, and is between six and eight inches wide. It resembles in everything the femur of a Tatou. I am going to send you one of his scales. The tail, as you have been able to see, is very short and very thick, and it also has shields, but they are not in the form of rings or whorls).

Figure 1. View of Montevideo drawn in 1832 during Darwin's voyage on the Beagle. On the left you can see the Cathedral and on the right the Cerro de Montevideo. Modified from King (1839).

Figure 2. Engraving of Dámaso Antonio Larrañaga (1771–1848). Modified from Lipski & Michon (1885), published on the cover of the Uruguayan newspaper *El Indiscreto*.

Briefly, the *Megatherium* that Larrañaga mentioned in his note corresponds to a colossal mammal collected in the city of Luján in 1787, sent to the Real Gabinete de Historia Natural de Madrid in 1788 and formally described by Cuvier (1976) as *Megatherium americanum* (Fig. 3) (Orche & Amaré, 2019a).

At that time, the support given by Cuvier (1823) to the content of Larrañaga´s note was the key to successfully

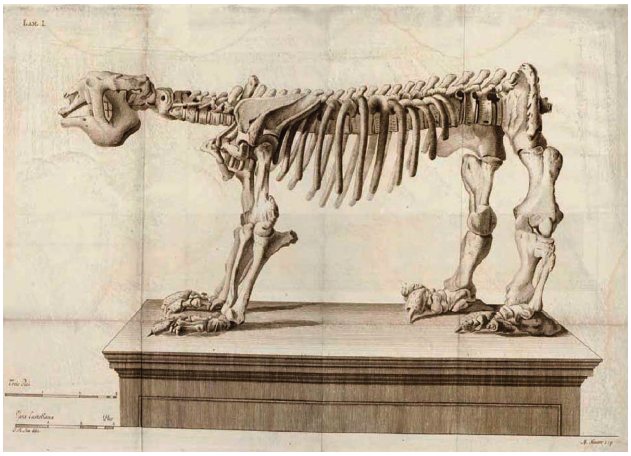

Figure 3. Reconstruction of ***Megatherium americanum*** drawn by Juan Bautista Bru based on the specimen housed at the Real Gabinete de Historia Natural of Madrid. Modified from Garriga (1796).

install the concept of 'armored *Megatherium*' in the scientific community (Fernicola *et al.*, 2009). Then, the German naturalist Christian Weiss (1780–1856) assigned a few osteoderms of the dorsal carapace and a fragment of caudal tube to *Megatherium*; these were recovered in Uruguay by the Prussian naturalist Friedrich Sellow (1789–1831) (Weiss, 1830). In 1835, William Clift (1775–1849) assigned part of a collection of fossil bones to *Megatherium* that were sent to England from Buenos Aires Province by Woodbine Parish (1796–1882), who was commissioned as Consul General at Buenos Aires on 1823 and served as *Chargé d'affaires* (charged with business) of Argentina from 1825 to 1832. Among the specimens, Clift (1835) described and figured an incomplete skeleton, isolated bone elements, and armor fragments (Fig. 4), collected in different places in Buenos Aires.

It was William Buckland (1784–1856), an English paleontologist, geologist, and theologian, who became Dean of Westminster in 1845, the one who in 1837 figured for the first time, in a double plate, the entire skeleton, parts of another skeleton, and two isolated osteoderms assigned to *Megatherium* (Fig. 5).

Fernicola *et al.* (2009) highlighted how the concept of 'armored *Megatherium'* allowed Charles Darwin, on his trip to South America, to recognize the presence of this animal from isolated osteoderms.

The information concerning the colossal mammal from Luján was used in different life reconstructions that were published in magazines of that time. According to Orche and Amaré (2019b), the first known graphic representation of the armored *Megatherium* was published by the magazine El Panorama in 1838. Orche and Amaré (2019b) recognized that this representation with slight modifications was used by Boitard (1861, p. 226, 239) and Huxley (1875, p. 351) (Fig. 6), while in Spain it was included in the Semanario pintoresco (Anonymous, 1841, p. 185–186) and in El Panorama (Anonymous, 1838, p. 357–358).

In 1835, some naturalists showed doubts assigning an exoskeleton to *Megatherium*. Among them, the German engraver and naturalist, Eduard d'Alton (1772–1840), when describing fragments of the endo and exoskeleton collected in Uruguay, remarked the similarity that these elements shared with armadillos (d'Alton, 1835). Another

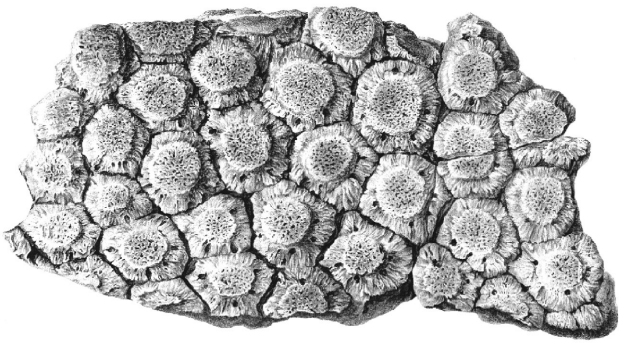

Figure 4. Fragment of dorsal carapace assigned to ***Megatherium*** by Christian Weiss (1780–1856). Modified from Weiss (1830).

author was the French zoologist and paleontologist Charles Léopold Laudrillard (1783–1853), who was in charge of the second edition of Cuvier's work. Laurillard (in Cuvier, 1836, p. 368) questioned the existence of the armored *Megatherium* in a footnote of volume VIII as follows: "*Il serait fort possible que le* Mégathérium *fût en effet recouvert de cuirasses écailleuses; cependant il ne faudrait pas se hâter de lui attribuer les grands fragmens qu'on en a trouvés, car les plâtres envoyés de Londres démontrent qu'un tatou de taille gigantesque existe, avec le Mégatherium, dans les plaines de Buenos-Ayres. Ces morceaux caractéristiques consistent dans un calcanéum, un astragale et un scaphoïde qui ne s'éloignent de ceux des tatous vivans que par la grandeur et par des différences purement spécifiques*" (It would be quite possible that the *Megatherium* was really covered with armor with scales; however, we should not hasten to attribute to him the large fragments that have been found, because the casts sent from London show that there is an armadillo of gigantic size, with the *Megatherium*, on the plains of Buenos Aires. These characteristic pieces consist of a calcaneus, an astragalus and a scaphoid which only differ from those of living armadillos in size and in exclusive specific differences).

It was the English biologist, comparative anatomist, and paleontologist Richard Owen (1804–1892), who definitely banished the idea that the armored *Megatherium* ever existed. His comparative anatomical study and detailed analysis of the geographic record of each of the pieces assigned to *Megatherium*, allowed Owen (1839) to establish that those bone elements anatomically assignable to *Megatherium* had not been recovered in association with osteoderms. In those cases, where the association between

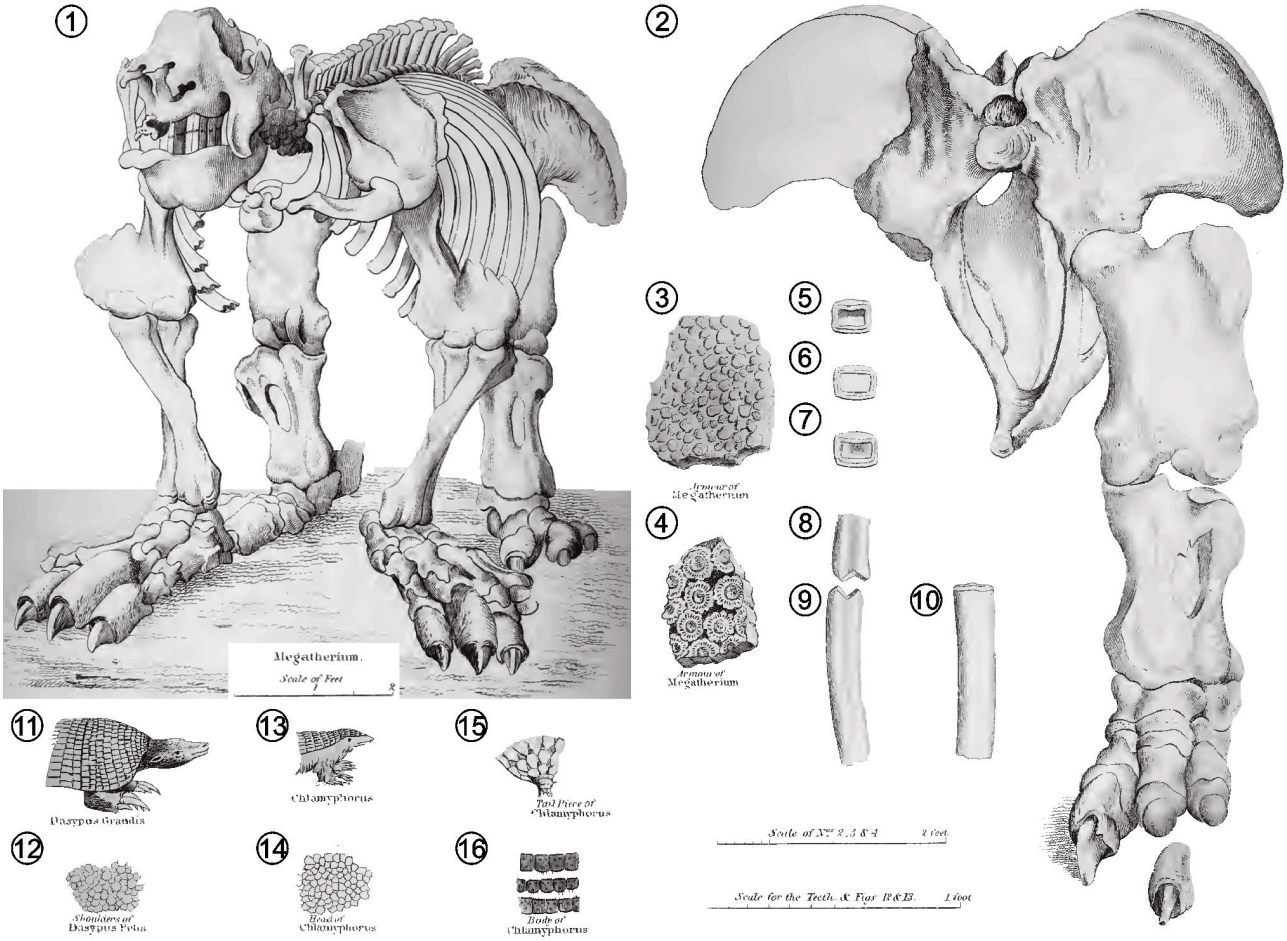

Figure 5. Double plate of Buckland (1837, p. 144, pl. 5). According to Buckland (1837, p. 19), the illustrations are as follows: "**1,** Skeleton of ***Megatherium***, copied from Pander & D'Alton's figure of the nearly perfect skeleton of this animal, in the Museum at Madrid. **2,** Bones of the pelvis of ***Megatherium***, discovered by Woodbine Parish, Esq. near Buenos Ayres, and now placed in the Museum of the Royal College of Surgeons, London. The bones of the left hind leg, and several of those of the foot, are restored nearly to their natural place (Original). **3, 4,** Armour, supposed to be that of ***Megatherium***. **5–10,** Teeth of ***Megatherium***. **11–16,** Armour of ***Dasypus*** and ***Chlamyphorus***. Modified from Buckland (1837).

endoskeleton and exoskeleton was reliable, they did not present similarities with the endoskeleton of *Megatherium*. In short, Owen (1839) demonstrated that megatheres were not armored and that the remains belonged instead to the group of mammals he called 'glyptodonts', a group closely related to armadillos. Regarding Larrañaga´s communication in Cuvier (1823), Owen (1839, p. 81) mentioned: "…The notion that the fossils here mentioned belonged to the *Megatherium* rests solely on the circumstance of the worthy Cure having inserted the word *Megatherium* as the synonym of his gigantic *Dasypus…*".

In Argentina, during the second half of the 19th century, the armored *Megatherium* of Larrañaga and Cuvier was incorporated by Burmeister (1864) as part of the historical background that he provided for the paleontology of vertebrates in the Río de La Plata. Ameghino (1889, p. 669) advanced on the causes that would have led to raise the possibility of an armored *Megatherium*, recognizing that the remains of *Megatherium americanum* "…*fueron enviados á Madrid, conjuntamente con algunos fragmentos de coraza de Glyptodon recojidos en el mismo yacimiento…*" (…were sent to Madrid, together with some fragments of *Glyptodon* armor collected in the same deposit…) and that it was this fact that had led Cuvier to "…*creer que el* Megatherium *había estado protegido por una coraza ósea como los armadillos*" (…believe that the *Megatherium* had been protected by a bony shell-

like armadillos) and, consequently, endorsed Larrañaga's idea.

Bosca y Casanova (1903), in his report on the state of the *Megatherium* collected in Luján during the 18th century, noted that "*...hay ejemplares en el Museo de Madrid, procedentes del mismo envío de la ribera del Lujan; piezas de coraza, sobre las que se fundó el género Glyptodon, al que precisamente pertenecen las aludidas partes conservadas en dicho Museo*" (...there are pieces in the Museo de Madrid, coming from the same shipment that came from the banks of Lujan; pieces of armor, on which the genus Glyptodon was founded, to which the aforementioned parts preserved in the Museum precisely belong).

Furlong (1948) and Méndez Alzola (1950) shared the hypothesis of a mixture of specimens from different taxa. The latter author proposed that while Larrañaga served as the Director of the Biblioteca de Buenos Aires between 1814 and 1815, he could have had access to the archives that reported the extraction of the *Megatherium* in Luján and that he found evidence in them to assign the fragments of carapace to *Megatherium*. Méndez Alzola (1950, p. 64) cited a note sent by Priest Fray Manuel Torres to the Viceroy on June 27th, 1787, in which it is read "*He encontrado la media cadera á mi ver, capaz de sujetarse al dibujo. Igualmente la cascara, no ha padecido daño considerable...*" (I have found the half hip in my view, capable of holding onto the drawing. Similarly, the shell has not suffered considerable damage...).

With the exception of those who knew or shared correspondence with Larrañaga and Ameghino, who partially accessed the scientific manuscripts through the historian José Andrés Lamas (1817–1891), no other naturalist could have had access to their writings and correspondences because most of them, including those referring to the *Megatherium*, were published between 1922 and 1930. Only Furlong (1948) and Méndez Alzola (1950) accessed these manuscripts, but as the previous authors, they supported the mixture of pieces that corresponded to different taxa as the fundamental element in the origin of the concept of the 'armored *Megatherium*'.

In this work, we focus on the analysis of Larrañaga's manuscripts and personal correspondence in order to judge whether the mixture of specimens was the cornerstone on which the idea of the armored *Megatherium* rests, a hypothesis preliminarily questioned by Fernicola (2018) and Fernicola & Castiñeira Latorre (2021, 2022). It should be noted that different passages of his studies open a window through which we can reconstruct his way of analyzing and classifying nature, while his personal correspondence with renowned naturalists from the Old World allow us to reconstruct some aspects of his interpretations of nature, classification of mammals, and contextualize his postulate. Thus, the objective of this study is to analyze what were the arguments that led Larrañaga to postulate that the *Megatherium* was an armadillo and what were the reasons why it was accepted by an important group of naturalists of that time.

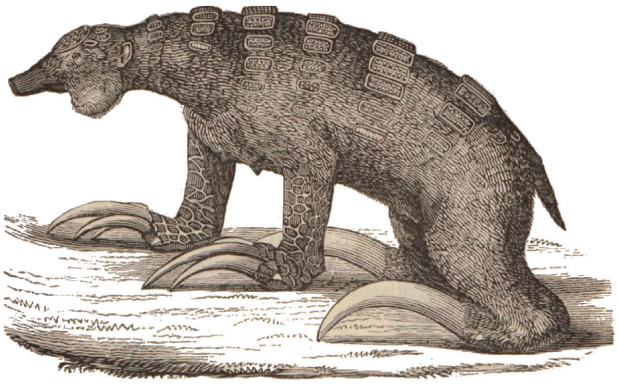

Figure 6. Representation in life of the armored ***Megatherium***. Modified from Huxley (1875).

MATERIALS AND METHODS

This study is based on primary sources from the Archivo General de la Nación (Argentina, AGN), Archivo Histórico (Uruguay, AGN AH), Archivo Museo Histórico Nacional (Uruguay, AMHN), and Archivos del Instituto Ravignani (https://ravignanidigital.com.ar/libros/larraniaga/lar_0000.html)

The taxonomic nomenclature used in this work is the one cited in the original works, manuscripts, and personal correspondence.

LARRAÑAGA AND THE NATURAL SCIENCES IN THE RÍO DE LA PLATA AT THE BEGINNING OF THE 19TH CENTURY

Among the many documents that connect us with the life history of Don Dámaso A. Larrañaga, we highlight one

of the first mentions that reveal his vocation towards natural sciences. The document corresponds to a draft written in Montevideo, in April 1804, and whose final destination would have been to become a letter sent to Barcelona, where the following request is exposed: "*...me proporcionen comunicación con algún sabio naturalista, que me dirija, y con quien pueda consultar las innumerables dudas que se me ofrecen sobre los tres reinos de la naturaleza; pues de todos ellos tengo colecciones y principios y quisiera perfeccionarlos*" (...give me communication with a wise naturalist, who can address me, and with whom I can consult the innumerable doubts that are offered to me about the three kingdoms of nature; because, I have collections and principles concerning all of them and I would like to improve them) (Larrañaga, 1922, p. 256).

Shortly after, it was not Larrañaga who requested academic assistance, but quite the opposite. In a letter dated June 22nd, 1808 and addressed to Don José Joaquín de Araujo (1726–1835), an official of the Real Hacienda del Virreinato and an amateur of natural history (Castellanos, 1948), he explained "*...la receta para conservación de los pájaros extractándola de un autor francés... ...En primer lugar se debe tener mucho cuidado en el modo de matarlos... ... El fusil es el arma más cómoda y la más propia... ...Mr. Manduyo es de parecer que el arco es una de las mejores armas... ... dejo en segundo lugar, que los pájaros se pueden conservar de dos modos o enteros o por medio de la piel solamente. El espíritu de vino y también el de la caña son licores que pueden servir para conservar pájaros enteros... ...Les he extraído las entrañas, y he llenado su capacidad de unos polvos hechos de alumbre, cal, sal y pimienta; lo mismo hacía con los ojos extrayéndolos, y aun los sesos por esta parte o por dentro del pico por el que introducía alguna porción de dichos polvos... ...Después de esto colgaba el ave por los pies, y la tenía así dos o tres días según el tamaño, y cuando la creía bien penetrada la acomodaba en aquella postura, que yo quería que tuviese, o que me parecía más natural; y de este modo la dejaba endurecerse. Este es un método muy fácil; pero siempre las aves se encogen y se desfiguran algún tanto...*" (...the recipe for the conservation of birds, extracting it from a French author... ...First of all, great care must be taken in the way of killing them... ...The rifle is the most convenient and most appropriate weapon... ...Mr. Manduyo is of the opinion that the bow is one of the best weapons..... I leave in second place, that the birds can be preserved in two ways, complete or through the skin only. The spirit of wine and also that of cane are liquors that can be used to preserve complete birds... ...I have extracted their entrails, and I have filled their capacity with some powders made of alum, lime, salt and pepper; I did the same with the eyes, extracting them, and even the brains in this part or inside the beak through which I introduced some portion of said powders... ...After this I hung the bird by its feet, and kept it like this for two or three days depending on the size, and when I thought it was well penetrated I would accommodate it in that position, which I wanted it to have, or which seemed more natural to me; and in this way I let it harden. This is a very easy method; but the birds always shrink and disfigure themselves somewhat...). Larrañaga ends his extensive letter with the following advice: "*...Prevengo que no se arranque la lengua, que es un carácter muy importante en el sistema de Linneo...*" (...I prevent you from tearing your tongue out, which is a very important character in Linnaeus's system...), and mentioned that "*...Esto es, amigo más bien mi práctica que la inspiración de dicho autor de quien me he separado en varias cosas. La práctica enseña mucho más que toda instrucción...*" (...This is, my friend, rather my practice than inspiration of such author from whom I have grown apart in various ways. Practice teaches so much more than all instruction...) (Falcao Espalter, 1921, p. 309–312).

In the same year, and in response to a query from Father Bartolomé Doroteo de Muñoz (second half of the 18th century–1831) regarding the study of botany, Larrañaga sent him on July 6th, 1808 (Falcao Espalter, 1921, p. 313–325) a detailed explanation regarding how to use Linnaeus' classification of 1758: "*...Yo alabo, amigo, y deseo que Ud. se dedique con seriedad a la Botánica. No es necesario para ello de talento alguno particular, pues el mío es bastante común. Sólo se requiere, según la expresión de Buffon, para las ciencias naturales, una paciencia más que estoica; y mucho más para el Reino interminable de la Botánica. La constancia es la que siempre ha hecho los sabios, no los talentos, y el de Ud., no sólo no es de los vulgares, sino que también está acompañado de una pasión decidida por estas ciencias, que no es de los menores requisitos. Yo, pues, confieso a Ud., por el grande amor que les profesa, que trate de hacerlo con formalidad, para*

aumentar la gloria de nuestro clero, y la felicidad de estas provincias. Yo solo poco puedo hacer, porque es adagio común entre los botánicos que: unus homo nullus homo*... ... Pero si Ud. tratase de hacerlo con formalidad, como me lo dice en su carta, debe principiar por el conocimiento de las 24 clases, cuya inteligencia es muy fácil siempre que se tenga cuidado con la distinción de los sexos de las flores, pues por esto llamó Linneo a su sistema sexual, que es el que Ud. debe seguir por ser hasta hora no sólo el más completo, sino también el más fácil, a pesar de lo que algunos nos quieren ponderar el nuevo Sistema Natural de Cuvier, que para mí tiene muchos más defectos y me parece menos exacto*" (...I praise you, friend, and I want you to dedicate yourself seriously to Botany. It is not necessary for it any particular talent, because mine is quite common. All that is required, according to Buffon's expression, for the natural sciences is more than stoic patience; and much more for the endless Kingdom of Botany. Constancy is what wise men have always done, not talents, and yours is not only not one of the vulgar ones, but it is also accompanied by a decided passion for these sciences, which is not one of the least requisites. I, then, confess to you, for the great love you profess for them, that you try to do it formally, to increase the glory of our clergy, and the happiness of these provinces. I alone can do little, because it is a common adage among botanists that: *unus homo nullus homo*... ... But if you try to do it formally, as you tell me in your letter, you must begin by knowing the 24 classes, whose intelligence is very easy as long as care is taken with the distinction between the sexes of the flowers, for this is why Linnaeus called their sexual system, which is the one you must follow because up to now it is not only the most complete, but also the easier, despite that some want to praise the new Cuvier's Natural System, which for me has many more defects and seems to me less exact).

Among the many indications that Larrañaga gave to Priest Muñoz, the following are included: "...*Sea, pues, su primer cuidado buscar la flor en la planta, si la tuviere visible; porque si no se encontrare, como sucede en las calagualas, en los hongos, en los musgos y en las algas o yerbas de la piedra, pertenecerá a la última clase o a la criptógama. Pero a excepción de esta, todas las otras 23 clases tienen sus flores visibles. Encontrada la flor se debe investigar su sexo: si es masculina, femenina o hermafrodita. Esto lo puede Vd. saber muy fácilmente, porque ya sabe distinguir los estambres de los pistilos: estos coronan el fruto tierno, y aquellos lo rodean. Las flores que tengan solamente estambres, son masculinas; las que tengan solamente pistilos son femeninas; y las que tengan unos y otros son hermafroditas...*" (...Let it be, then, your first care to look for the flower on the plant, if it is visible; because if it is not found, as it happens in the calagualas, in the fungi, in the mosses and in the algae or herbs of the stone, it will belong to the last class or to the cryptogam. But except for this one, all the other 23 classes have their flowers visible. Once the flower is found, its sex must be investigated: if it is male, female or hermaphrodite. You can know this very easily, because he already knows how to distinguish the stamens from the pistils: these crown the young fruit, and those surround it. The flowers that have only stamens are masculine; those with only pistils are female; and those that have both are hermaphrodites...) (Falcao Espalter, 1921, p. 313–325).

Larrañaga continued with an exhaustive explanation of each of Linnaeus's classes and culminated with "*Yo creí amigo escribir una carta y he escrito una Disertación. Alguno quizás encontrará cierta novedad, y método en ella, pero el único que yo encuentro es la abundancia de ejemplos en todas las clases, y de plantas conocidas por todos nosotros: este es el defecto, que para mí siempre tuvieron todas las obras botánicas que he visto, y que era muy natural que así fuese, porque los nombres vulgares son tan variables, o aún más que los terrenos en que se crían las plantas. ¡Cuántas horas de estudio, y cuantos quebraderos de cabeza hubiera ahorrado si hubiera sabido estos ejemplitos! Estudie Vd. bien esas plantas, reconozca bien todas sus estambres, y reuniendo con ellas todas que se le parezcan, las tiene ya Vd. con solo esto a todas perfectamente clasificadas...*" (I thought my friend that I was writing a letter and I have written a Dissertation. Perhaps someone will find a certain novelty and method in it, but the only thing that I find is the abundance of examples in all classes, and of plants known to all of us: this is the defect, which for me has always been the case with all the botanical works that I have seen, and that it was very natural for it to be so, because common names are as variable, or even more so, than the land on which the plants are raised. How many hours of study, and how many headaches I would have saved if I had known these examples! Study these plants

well, recognize all their stamens well, and gathering with them all that are similar, you already have them, with just this, all of them perfectly classified...) (Falcao Espalter, 1921, p. 313–325).

In the speech that Larrañaga gave in 1816 on the inauguration of the Biblioteca Pública de Montevideo, he established the need to "*Estudiad el gran libro de la Naturaleza, de esa madre fecunda y siempre nueva. Vuestros descubrimientos harán honor á vuestra patria y aumentarán los renglones de su tráfico y cultivo. Linneo, el hijo más querido, el hijo más fiel, á quien ha revelado todos sus arcanos; Buffon, el Plinio francés, su elocuente panegirista Castel, su compendiador Tournefort, Jussieu, Ruiz y Pavón, Cavanilles, Ortega, Azara, y otros célebres expositores de la Naturaleza que adornan estos estantes, son los mejores maestros que pueden dirigirnos en tan importantes investigaciones; vuestro país abunda en producciones nuevas; y en este corto recinto, en medio de las más serias ocupaciones de mi ministerio, he clasificado y descrito sistemáticamente más de mil especies desconocidas en sus tres reinos*" (Study the great book of Nature, of that fecund and ever new mother. Your discoveries will honor your country and increase the lines of its traffic and cultivation. Linnaeus, the most beloved son, the most faithful son, to whom he has revealed all his secrets; Buffon, the French Pliny, his eloquent panegyrist Castel, his abridger Tournefort, Jussieu, Ruiz y Pavón, Cavanilles, Ortega, Azara, and other famous expositors of Nature who adorn these shelves, are the best teachers who can guide us in such important investigations; your country abounds in new productions; and in this short enclosure, in the midst of the most serious occupations of my ministry, I have systematically classified and described more than a thousand unknown species in its three kingdoms) (Larrañaga, 1951, p. 14).

In the transcribed passages of the letters that we quoted above, we can glimpse how Larrañaga prepared himself to study nature, and in the selected passages of his inaugural speech at the Biblioteca Pública de Montevideo, we can consider how such preparation came to fruition. It is hard to establish whether more than a thousand new species were actually incorporated into science by Larrañaga, but in his *Diario de Historia Natural*, written between 1808 and 1824 (Larrañaga, 2015, 2017), approximately that number of taxa were recognized as either new or previously known.

Throughout his studies, the number of species reported in 1816 changed, in part, due to access to new bibliography, as can be seen in his letter sent to Bonpland in February 1818 (Larrañaga, 1924, p. 284) or in his work entitled *Geología del Río de La Plata* (Larrañaga, 1894, 1924), which is assumed to have been written in 1819 (Lamas, 1879). In the latter work, Larrañaga (1924, p. 7–8) recognized that "...*En los primeros años de mi estudio, me dexé llevar de aquella manía del siglo, o mejor dicho de aquella inocente distracción de estudios más serios, acopiando los testáceos más hermosos que nuestro país producía o que de fuera podía conseguir... ...Habiéndolas clasificado y encontrándolas casi todas nuevas en el sistema de Linneo procuré a exemplo de nuestro primer padre, darles aquellos nombres que me parecieron más conformes al estado de esta ciencia. Pero al mismo tiempo el sabio Maton leía en 1809 una memoria a la Sociedad Linneana de Londres en que describía unas conchas del Río de La Plata, siguiendo el mismo sistema de su titular, y advertí que había hecho el mismo juicio que yo en su extrañeza y novedad, dándoles también nuevos nombres. El se ha anticipado en su publicación y tiene un derecho a que se conserven éstos y no los míos, quando no choquen con los progresos que han hecho las ciencias. Yo, pues, los denominaré en esta Memoria, según lo hace el sabio en la suya*..." (...In the first years of my study, I let myself be carried away by that mania of the century, or rather that innocent distraction from more serious studies, collecting the most beautiful testaceans that our country produced or that could be obtained from abroad... ....Having classified them and finding them almost all new in Linnaeus's system, I tried, following the example of our first father, to give them those names that seemed to me to be more consistent with the state of this science. But at the same time, in 1809, the wise Maton was reading a memoir to the Linnean Society of London in which he described some shells from the Río de La Plata, following the same system as the owner, and I noticed that he had made the same judgment as me in his strangeness and novelty, also giving them new names. He has anticipated their publication and has a right to preserve these and not mine, when they do not clash with the progress that science has made. I, then, will name them in this Memory, as the wise man does

in his…). After these considerations, Larrañaga (1924, p. 8) founded a new taxon in the following terms: "*En esta familia establecida por Cuvier solo deben colocarse aquellas bivalvas que a más de otros caracteres tengan sus extremos más o menos entreabiertos; y según confesión del Sr. Matón* valvae sunt ochisissima*. A más de ésto la valva inferior está como partida en su charnela y en su fondo se halla la cavidad o foveola del ligamento. Creo, pues, que debe hacerse un nuevo género.* Matonia antigua*…*" (In this family established by Cuvier, only those bivalves should be placed that, in addition to other characters, have their ends more or less open; and according to the confession of Mr. Matón *valvae sunt ochisissima*. In addition to this, the inferior valve is as if split in its hinge and at its bottom is the cavity or foveola of the ligament. I therefore believe that a new genre should be made. *Matonia antigua*…).

This work clearly reflects how meticulous Larrañaga was as a naturalist. He recognized that many of his taxa did not have priority and, therefore, did not mention them in his study, but he named *Matonia antigua*, whose specimens had been considered by him as *Mya labiata* and *Tellina marina*, as can be seen in his notes on the shells of the Río de La Plata in his *Diario de Historia Natural* of August 1815 (Larrañaga, 1922, p. 40). It should be noted that if the taxon had been published by Larrañaga in 1819, *Matonia antigua* would have to be considered a junior synonym of *Erodona mactroides* (Daudin en Bosc, 1801) (Méndez Alzola, 1950, p. 88; Martínez, 1998). Something similar happened with a new genus of rodent that he described in the note published by the Société Philomatique in Paris, in which the armored *Megatherium* was reported for the first time (Larrañaga, 1823a). The description of the rodent was made in the following terms: "…*Le Quyia d'Azzara doit ètre séparé de* l'Hydromys *et faire un genre nouveau, à cause de ses 4 maxillaires demi-composées et compliquées de chaque côté des deux mandibules. C'est mon genre* Potamys*, voisin du* Castor*…*" (…The Quyia d'Azzara must be separated from the *Hydromys* and make a new genus, by the presence of 4 semi-compound and complicated maxillae on each side of the two mandibles. It's my genus *Potamys*, neighbor of *Castor*….) (Larrañaga, 1823a, p. 83). The dental characteristics mentioned by Larrañaga (1823a) led him to create a new genus, but as happened with *Matonia*, a new taxon had already been named from specimens collected in Chile as *Mus coypus* by Molina (1782), that later Kerr (1792) recognized as the type species of the genus *Myocastor*.

THE *MEGATHERIUM* AND THE CONSTRUCTION OF ITS PROPOSAL

Larrañaga (1823a) commented that he would write a memoir of the *Megatherium*. Whether it was written or not we do not know, but, to date, no manuscript on this topic has been found among his documents.

The first mention that we find of *Megatherium* corresponds to a note included in his *Diario de Historia Natural* dated July 1814 and, more precisely, to a translation of the *Megatherium* description published in the 12th volume of the Encyclopaedia Britannica of 1810. In this brief description, which lacks any figures and/or diagrams, it is mentioned that "…Some years ago, there was discovered below the surface of the earth in South America, an entire fossil skeleton of an animal at present unknown; but which M. Cuvier found to resemble the present genus [*Bradypus*] more than any other. From its vast size, Cuvier gave it the name of *Megatherium*, and he has given the following description of it in the Annales de Museum National, accompanied with a figure: This skeleton is twelve feet (French) long, by fix feet in height… … The thigh bones are excessively thick, and the leg bones still more so in proportion; the entire sole of the foot bore on the ground in walking; the shoulder blade is much broader than long… … To judge by the form of the last phalanges, there must have been very large pointed claws, enclosed at their origin in a long sheath. There appears to have been only three of these claws on the fore feet, and a single one on the hind; the other toes seem to have been deprived of them, and, perhaps, entirely concealed beneath the skin… … The head is the greatest singularity of this skeleton; the occiput is elongated and flattened, but is pretty convex above the eyes; the two jaws form a considerable projection, but without teeth, there being only four on each fide above and below, all grinders, with a flat crown, and grooved across…" (Larrañaga, 1922, p. 4–5).

Other studies consulted by Larrañaga (1922, p. 68) such as the *Tableau élémentaire de l'histoire naturelle des animaux* by Cuvier (1798, p. 145–146), has similar information: "…*le*

squelette d'un quadrupède, dont l´espèce a peut-être péri, et qui a beaucoup de rapport avec les paresseux par la forme de sa tête et les proportions de ses membres, mais qui est long de donze pieds, et n'a que des molaires, sans incisives ni canines. On l'a nommé Megatherium" (...the skeleton of a quadruped, whose species may have perished, and which bears much relation to sloths in the shape of its head and the proportions of its limbs, but which is twelve feet long, and has only molars, without incisors or canines. It was named *Megatherium*).

The absence of drawings of *Megatherium* in the aforementioned works was replaced by a drawing of this mammal (Fig. 7) that is still kept in his archives. According to Méndez Alzola (1950), this drawing is a copy of one drawn at the end of the 18th century by Lieutenant Francisco Javier Pizarro, commissioned by the Marqués de Loreto, Viceroy of the Río de la Plata (Mones, 2002). It should be noted that a watercolor illustration housed at the División Paleontología de Vertebrados of the Museo de La Plata is preserved with the following dedication: "*Al Sr. Dn. Damaso Antonio Larrañaga ofrece este diseño del raro esqueleto desenterrado de las barrancas del Río Luján el año 1785 y enviado por el Exmo Sr. Virrey Marques de Loreto al Real Gabinete de Historia Natural de Madrid. su affmo. amigo Bartolomé Muñoz*" (To Mr. Dn. Dámaso Antonio Larrañaga offers this design of the rare skeleton unearthed from the cliff of the Río Luján in 1785 and sent by His Excellency viceroy Marqués de Loreto al Real Gabinete de Historia Natural de Madrid. his affmo. friend Bartolomé Muñoz) (Ramirez Rozzi and Podgorny, 2001) (Fig. 8). So, it is possible that Larrañaga's drawing was based on Muñoz's watercolor and not on Pizarro's original illustration. The extensive description of *Megatherium* included in the Encyclopaedia Britannica of 1810 and its drawing preserved in its archives can be considered two of the most important sources of information that Larrañaga had when classifying the colossal mammal from Luján.

In support of this hypothesis, it is important to note that in the same folder in which his 1819 geological notes were preserved, a peculiar paragraph about the Luján giant is conserved: "...*Pero en parte alguna se ha encontrado nada más gigantesco ni extraordinario como el* Megatherium *de Cuvier, que se encontró en el Rio de Luxan, que ya ha perecido y solo tiene representante a nuestros Tatus, matacos, mulitas y quirquinchos. Aquel profundo maestro y fundador de la Anatomía comparativa me permitirá que me separe de su*

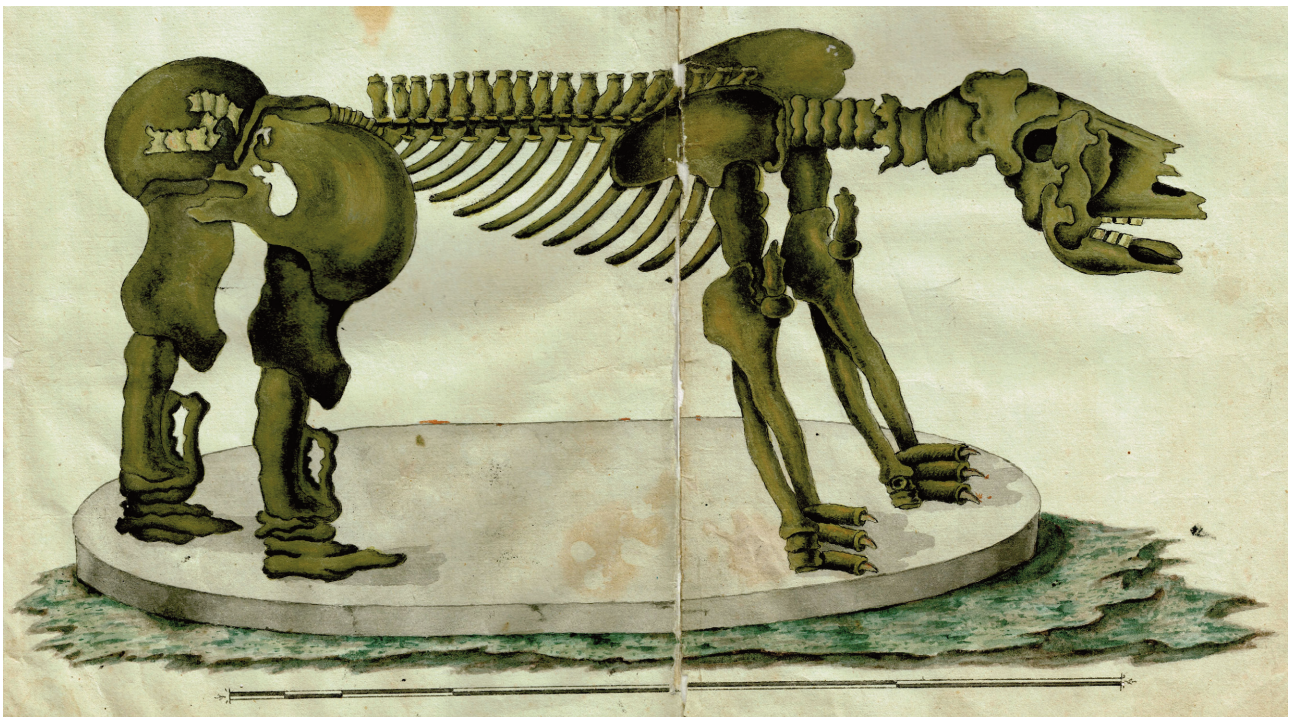

Figure 7. Reconstruction of the ***Megatherium*** skeleton preserved in the Larrañaga archives. **UY 11100 AGN AH Ex AMHN**.

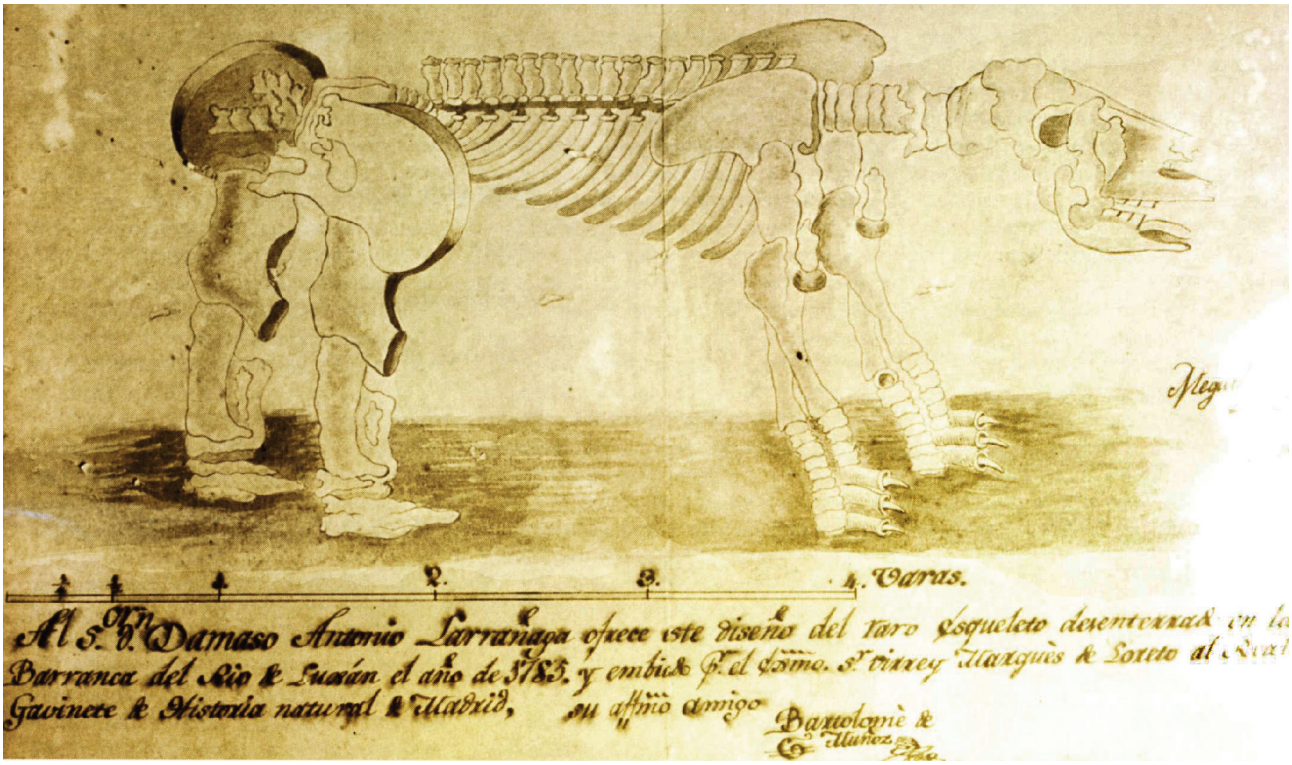

Figure 8. Reconstruction of the ***Megatherium*** skeleton dedicated to Priest Larrañaga by Priest Muñoz. Modified from Ramirez Rozzi & Podgorny (2001).

opinión en esta parte. La boca con solo molares, sus huesos cortos y muy anchos, su testa ósea tan grande como un horno de panadería; su cola cubierta de grandes escudas que conservamos, indican de un modo indudable que no puede ser sino un subgénero de nuestros Tatus; y nos permitirá que en este sentido lo denominemos en adelante Megaterium Cuvierii..." (...But nothing more gigantic or extraordinary has been found as the Cuvier's *Megatherium*, which was found in the Río de Luxan, which has already perished and only has a representative of our Tatus, matacos, mulitas and quirquinchos. That wise teacher and founder of Comparative Anatomy will allow me to differ from his opinion in this part. The mouth with only molars, its short and very wide bones, its bony head as big as a bakery oven; its tail covered with large bone plates that we preserve, undoubtedly indicate that it can only be a subgenus of our Tatus; and will allow us to name it *Megatherium Cuvierii* from now on...) (Larrañaga, 1924, p. 23).

Beyond the anatomical characteristics recognized by Larrañaga, the name *Megatherium cuvierii* shows that when writing the note, he was unaware that Cuvier in 1796 had named the large mammal from Luján as *Megatherium americanum*. In support of this idea, the specific name of Cuvier has not been found in any of the preserved manuscripts of the Presbyter. In summary, it is possible that the only relevant information that Larrañaga had regarding the anatomy and morphology of the *Megatherium* was what he transcribed from the Encyclopaedia Britannica of 1810 and the figure of *Megatherium*.

It is from this anatomical and morphological information published that Larrañaga proposed the classification of *Megatherium*. The 12th volume of this encyclopaedia, besides including the previously transcribed anatomical description of *Megatherium*, contains Cuvier's classification of mammals in the following terms: "According to Cuvier's arrangement, the Mammalia are divided into three general orders: 1. Those having claws or nails; 2. Those having hoofs; and, 3. Those having feet like fins: a division very similar to that of Mr Pennant. The first of these orders is subdivided into those mammalia that have three sorts of teeth, and those that want at least one kind of teeth". This division includes: I, Bimanum; II, Quadrumana; III, Sarcophaga; IV, Rodentia,

and at "V. EDENTATA, or those mammalia which have neither cutting nor canine teeth. This family comprises three genera, *viz.* MYRMECOPHAGA, or Ant-Eaters, comprehending the subgenera of myrmecophaga, echidna or porcupine ant-eater, and manis or sealy lizard; ORYCTEROPUS, or Cape Ant-Eaters; and DASYPUS, or Armadillos" and "VI. TARDIGRADA, or such as are deficient only in cutting teeth. Of this family there is only one genus, viz. BRADYPUS, or Sloths, under which Cuvier arranges as a subgenus, the unknown animal which he calls *Megatherium*." (Anonymous, 1810, p. 451).

As can be seen in Larrañaga's schemes on the classification of mammals entitled "*Clasificacion de los Mamilares del Rio de la Plata, particularmente de su Banda Oriental segun el Sistema de Cuvier, con sus caracteres acomodados al Pais*" (Fig. 9), and "*Clasificacion de los mamilares de este Pais segun el Sistema de Cuvier*" (Fig. 10), Larrañaga did not recognize Cuvier's *Megatherium* as a sloth. In these schemes, Cuvier's *Megatherium*, characterized as a colossal animal, is included within the Family Edentata and assigned to the genus *Dasypus*, based on the hierarchical use of the following anatomical sequence: 1. Those having claws or nails, and 2. Those Mammalia which have neither cutting nor canine teeth (see Figs. 9, 10). It is possible to argue that Larrañaga recognized *Megatherium* as a subgenus of *Dasypus* for two reasons. On the one hand, the generic name at that time included all known armadillo species; on the other hand, he maintained the hierarchical level proposed in the Encyclopaedia Britannica, in which *Megatherium* was considered a subgenus of *Bradypus*.

It should be noted that Larrañaga's scheme entitled *Clasificación de los mamilares de este País según el Sistema de Cuvier* includes within the Tardigrada a second species of megathere named *Megatherium cataphractus*. Although we do not have more information regarding this species and as already highlighted by Méndez Alzola (1950, p. 84), it is possible to argue that the generic assignment can be considered preliminary since Larrañaga (1924, p. 7–8) knew the nomenclature rules used at that time and, therefore, would not have used the same generic name for two species located in families so close to each other. However, this assignment is interesting given that the presence of an external bone cover, inferred from the specific name, did not prevent Larrañaga from including an armored animal among sloths, showing that the armor was not a main characteristic for him.

This lower hierarchy of characters related to the external covering of animals is observed in the classification included in the Encyclopaedia Britannica. In fact, the absence of teeth led to the inclusion of the pangolin *Manis* and the echidna *Echidna* in the Edentata as subgenera of *Myrmecophaga,* whose external coverings differed remarkably from each other: coarse hair and spines in *Echidna*, hair in *Myrmecophaga*, and overlapping plate-like scales in *Manis*.

THE *MEGATHERIUM* AND ITS INTERNATIONAL LINKS

The inclusion of Larrañaga's note in Cuvier's work gave strong support to its content. Cuvier (1823, p. 191) presentation strongly supported Larrañaga's hypothesis of the armored *Megatherium*: "*...Al´instant ou l´on achève l´impression de cette section, M. Auguste de Saint-Hilaire, savant botaniste, qui vient de farrea u Brésil le voyage le plus intéressant, et d´y rassembler les collections les plus riches, me communique l´extrait suivant de la lettre d´un savant Brasilien, qui annonce que le* Mégatherium *auroit poussé son analogie avec les tatous jusqu´a être comme eux revétu de cuirasses écailleuses. Nous devons attendre avec impatience le mémoire important que cette lettre nous promet..."* (...When finishing with the printing of this section, Mr. Auguste de Saint-Hilaire, a wise botanist, who has just made a most interesting trip to Brazil and collected rich collections there, communicated to me the note of a Brazilian scholar that follows, announcing that the *Megatherium* would have taken its analogy with the tatou until it was, like them, covered in a shell with scales. We will have to wait impatiently for the important memory that this letter promises. The recognition of Larrañaga as a wise man, the same term applied to Saint-Hilaire, presents him to the international community as a select colleague).

It is possible to reconstruct the origin of this recognition from his personal correspondence with different naturalists from the Old World. The first epistolary exchange was with the famous French naturalist, settled in the Río de La Plata, Aimé Bonpland (1773–1858), who traveled with Alexander von Humboldt around Latin America from 1799 to 1804. In his letter sent to Larrañaga from Buenos Aires on February

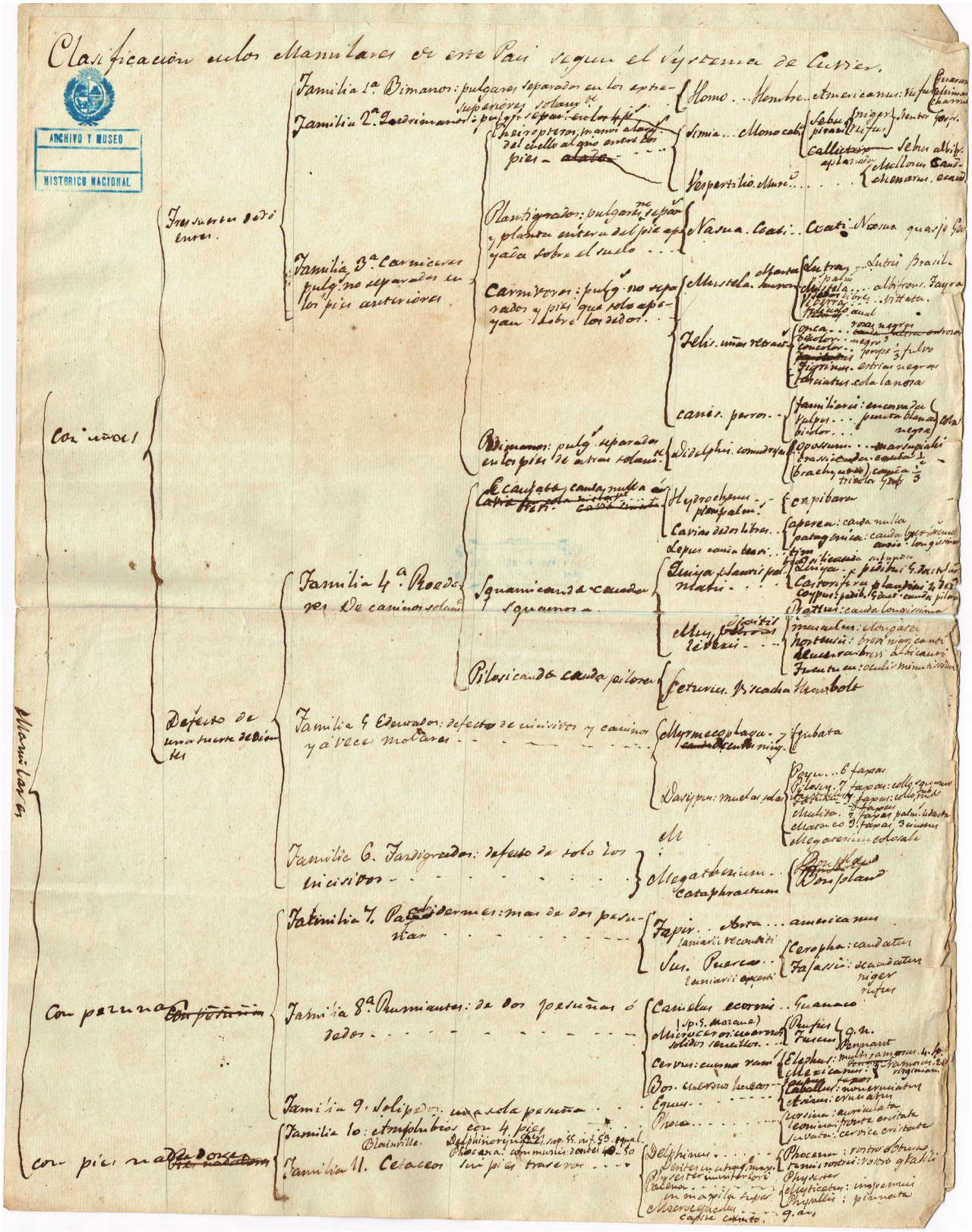

Figure 9. *Clasificación de los Mamiferos del Río de la Plata, particularmente de su Banda Oriental según el Sistema de Cuvier, con sus caracteres acomodados al País* (Classification of the mammals of the Río de la Plata, particularly its eastern band according to the Cuvier system, with their characters adapted to the country), preserved in the Larrañaga archives. **UY 11100 AGN AH Ex AMHN**.

Figure 10. *Clasificación de los mamilares de este País según el Sistema de Cuvier* (Classification of the Mammals of this country according to the Cuvier system), preserved in the Larrañaga archives. **UY 11100 AGN AH Ex AMHN**.

13th, 1818, Bonpland introduced himself as follows: "*Il y a déja plusieurs années que j'ai l'honneur de vous connottre de réputation et chaqué jour le désir de vous connoitre personellement s'augmente. Ce n'est que depuis quelques - jours que j'ai appris positivement votre retour á Monte-Video et si je n'étais retenu ici par des occupations que je ne puis quitter je serais moi - même le porteur de ma lettre. Je remetrai done mon voyage á Monte-Video á une époque plus éloignée si vos affaires ne vous apellent pas ici, malgré le désir extréme que j'ai de m'entretenir avec vous et de jetter un coup d'ceil dans vos belles collections de plantes, d'insects, de minéraux, etc. Je suis particuliérement instruit de tous vos travaux útiles et de votre noble ardeur pour les sciencies par Monsieur Segurola et par Don Bartholo Muñoz*" (I have had the honor of knowing you by your reputation for several years, and every day my desire to meet you personally increases. It was only a

few days ago that I positively learned of your return to Montevideo and if I were not held here by occupations that I cannot leave, I would myself be the bearer of my letter. So, I will postpone my trip to Montevideo for a more distant time if your business does not bring you here. Despite the immense desire I have to talk with you and take a look at your beautiful collections of plants, insects, minerals, etc. I am particularly well informed of all your useful works and your noble desire for science by Mr. Segurola and Don Bartholo Muñoz) (Larrañaga, 1924, p. 257).

In response to the previous letter, Larrañaga (1924, p. 284) wrote to him, from Montevideo on February 26th 1818, inviting him to maintain continuous epistolary contact and giving him a brief detail of the structure of his scientific works: "*Es cierto que aunque retirado en estos últimos pueblos de la América del Sur en que apenas llegaba algún libro de la Hist.a N.l y en donde casi ningún naturalista habia fixado una vista científica, tuve el atrevimiento de emprender el vasto proyecto de describir cientificamen.te los tres reynos de la Naturaleza de este Pais, siguiendo el Sistema Naturae de Linneo, edición de Gmelin. Entregado a mi mismo y solo con este gran Maestro y algún otro expositor, he llegado a reunir muchos e interesantes materiales en quienes por entonces encontraba más novedad que ahora, q.e con la abundancia de Libros he conseguido catálogos mas completos, y que me han obligado a reducir el numero de mis nuevos géneros y especies, principalm.te de plantas*". (It is true that although retired in these last towns of South America, where hardly a book of Natural History arrived and where almost no naturalist had fixed a scientific glance, I had the audacity to undertake the vast project of scientifically describing the three kingdoms of Nature of this Country, following Linnaeus' Naturae System, Gmelin's edition. Devoted to myself and alone with this great Master and some other expositor, I have come to gather many interesting materials in which I found more novelty then than now, that with the abundance of Books I have obtained more complete catalogues, which have forced me to reduce the number of my new genera and species, mainly of plants).

Other letters followed, but one from May 25th, 1818, sent to Bonpland by Larrañaga (1924, p. 267–268) stated: "*...estado del reyno animal que abrazan 62 mamíferos, 142 aves, 33 anfibios y 65 peces clasificados según la edición 13 del Systema Naturae de la resplandeciente Estrella polar del Norte... ...No obstante, como es preciso seguir la moda y conformarse a las luces que nos suministra el siglo 19 remito a Ud. Los mamilares clasificados por el nuevo método y también con algunas innovaciones mías, ya que nos es permitido a todos metodizar. Los caracteres que presento son originales y acomodados solamente al País...*" (...state of the animal kingdom that includes 62 mammals, 142 birds, 33 amphibians and 65 fish classified according to the 13th edition of the Systema Naturae of the resplendent Pole Star of the North... ...However, as it is necessary to follow fashion and conform to the lights that the 19th century gives us, I refer you the mammals classified by the new method and also with some innovations of my own, since we are all allowed to methodize. The characters that I present are original and accommodated only to the Country...).

Bonpland's response was encouraging "... *Je suis dans la plus grande admiration de tous vous travaux; ils sont immenses; ils surpassent, j´ose le dire, toute idée exagérée qu´on pouvait en avoir concu, il est incroyable que, seul dans ce pays, livré à l´étude d´Histoire naturelle, sans guide, sans livres vous eussiez pu réunir tant d´objets différents et les classer comme vouz l´avez fait...*" (...I deeply admired of all your works, they are immense. They exceed, I dare say, any exaggerated idea that could have been conceived; It is incredible that you alone, in the country, dedicated to the study of Natural History, without a guide, without books, have been able to gather so many different objects and classify them as you have done) (Larrañaga, 1924, p. 270). Next, the first reference to the *Megatherium* appears in the following terms: "*...Mr Abadie m´a dit, si je l ái bien compris, que vous aviez des os du grand squelette trouvé à Luxan et que j´ai vu dans le Museum de Madrid. Si veritablement vouz avez de ces os je serais bien d´avis que vous les conservassiez pour le pays. Vous pourriez en faire un dessin reduit et l´envoyer en Europe et on serair très reconnaissant de ce cadeau. Cuvier est le seul homme auquel cela convient et peu-être serait-il plus convenable d´adresser les dessins au Ministre de l´Intérieur pour le Museum d´Historie naturelle, ou directement au Museum et dans l´un et l´autre cas écrire à Cuvier... ...Revenons á vos savants et trés intéressants tableaux! Chaqué fois que je les régarde, ce qui m'arrive souvent, mon admiration s'augmente et je crois que vous feriez une chose utile á votre*

gloire scientifique de les faire publier en Europe..." (... Mr. Abadie told me, if I understood correctly, that you had bones from the great skeleton found in Luxan and that I saw in the Madrid Museum. If you really had those bones, I would be of the opinion that you should keep them for the country. You could make a reduced drawing and send it to Europe and they would be very grateful for that gift. Cuvier is the only man to whom that is convenient and perhaps it is best to address the drawings to the Minister of the Interior, to the Museum of Natural History, or directly to the Museum and write to Cuvier in either case. Forgive, I beg you, my suggestions in this regard, and have the conviction that I am doing it in yours and in your country's interest...) (Larrañaga, 1924, p. 271).

Bonpland's response showed how important Larrañaga's studies were for him, and he offered advice on how to publish them in Europe: "*...Revenons á vos savants et trés intéressants tableaux! Chaque fois que je les régarde, ce qui m'arrive souvent, mon admiration s'augmente et je crois que vous feriez une chose utile á votre gloire scientifique de les faire publier en Europe. Si vous étes de cet avis et que vous désiriez que je vous indique la marche que je crois la plus convenable, je le ferai avec autant d'empressement que de plaisir.*" (...Let's go back to your very erudite and interesting schemes! Every time I look at them, and this often happens to me, my admiration increases and I think that you would do a useful thing for your scientific glory by having them published in Europe. If you were of that opinion and would like me to indicate the course that seems most convenient to follow, I would do so with great pleasure and solicitude) (Larrañaga, 1924, p. 271). At the moment, it is not possible for us to establish whether Larrañaga's work was preserved in any institution, although it is very likely that Larrañaga may have included part of the information that is preserved on vertebrates among his manuscripts in either table or text format.

This link with the naturalists from the Old World was reinforced with the recurring visits of the French botanist Auguste de Saint-Hilaire to his house in Montevideo during 1820. In the letter that he sent from Brazil on January 15th, 1821, Auguste de Saint-Hilaire wrote to Larrañaga the following: "*Je ne veux pas tarder plus longtemps à vous exprimer combien j'ai été sensible aux honnetetés que j'ai regues de vous pendant mon séjour á Montévidéo. Depuis Rio de Janeiro je n'avais trouvé personne avec qui je pusse m'ontretenir de mes études favorites et je me rappellerai longtemps avec regret les soirées agréables que vous m'avez fait passer...*" (...I do not want to delay any longer expressing to you how much I was sensitive to the honesty that I received from you during my stay in Montevideo. Since Rio de Janeiro, I have not found anyone with whom I could talk about my favorite studies and I will long miss the pleasant evenings that you gave me) (Larrañaga, 1924, p. 277). The letter continues with the following terms: "*...Les deux nottes que vouz avez eu la bonté de me communiquer seront remises à la Societé Philomatique. Cette Societé qui compte parmi ses membres les savants les plus distingués de l´Institut, est de toutes les societés libres qui existent en Europe, celle peut-être qui a le plus contribué aux progres que les sciences ont faite depuis vingt années... ... Sachant combien elle peut gagner en acquérant un correspondant aussi instruit que vous, j´ais pris la liberté de vous proposer comme tel, et je ne doute pas qu´elle ne s´empresse à vous admettre dans so sein. J´espère, Monsieur, que vous voudrez bien m´excuser de ne pas vous avoir consulté auparavant...*" (...The two notes that you have kindly sent me will be sent to the *Societé Philomatique*. This society, which counts among its members the most distinguished sages of the institute, is of all the free societies that exist in Europe the one that perhaps has contributed the most to the progress of science in the last twenty years... ...knowing how much it can gain acquiring a correspondent as educated as you, I have taken the liberty of proposing it as such and I do not doubt that she will hasten to admit it to her bosom. I hope, sir, that you will excuse me for not having consulted it before. I did not think about it while I was in Montevideo, and currently the distance does not allow us to maintain an active and continuous correspondence...) (Larrañaga, 1924, p. 277–278). Unlike Bonpland, Saint-Hilaire began to establish himself as the link between the wise man of Montevideo and the institutions and naturalists of the Old World. In addition, not only the exchange of ideas is verified, but Saint-Hilaire accessed the collection of objects that Larrañaga housed at his private museum (Saint-Hilaire, 1887, p. 183–184) for which Larrañaga's observations could be confronted with the objects that generated them.

In 1821, Larrañaga met the naturalist Louis Claude de Freycinet in Montevideo and a short time later, on March 29th, 1822, the latter wrote him an extensive letter from Paris in which he mentioned: "*...J´imagine, Monsieur, que vous continuez toujours à vous livrer à vos doctes occupations; les savans français seraient bien aise de pouvoir jouir des fruits de vos recherches; j´espère que vous voudrez bien les leur communiquer quelquefois. Mr. Cuvier, auquel j´ai parlé de vos découvertes en histoire naturelle, serait fort satisfait des communications que vous voudriez bien lui faire; et la Société de Geographie à laquelle j´ai parlé de vous comme d´un savant qui pouvait utilement favoriser ses vues pour l´avancement de la belle science qui fait l´objet de son institution, désire vous avoir au nombre de ses correspondants. Vous recevres bientôt je pense une lettre spéciale à ce sujet et j´ose espérer que vous voudrez bien satisfaire à nos voeux... ...Je me flatte, Monsieur, que vous voudrez bien m´honorer de terms de vos lettres; s´il vous est possible de me comuniquer les observations météorologiques que vous avez faites et devez faire pendant 1821, 1822 et 1823 je serais bien aise de les avoir et que vous me permittiez de les citer dans mes ouvrages...*" (...I imagine, sir, that you always continue to devote yourself to your scholarly occupations; how happy the French scholars would be to be able to take advantage of the fruits of your investigations. I hope that you will kindly communicate with them sometime. Monsieur Cuvier, to whom I spoke of your discoveries in natural history, would be very pleased to receive any communications that you would make to him, and the Geographical Society to which I spoke of you as a scholar who could usefully further their aims for the advancement of the beautiful science that forms the object of the institution, it wishes to have it in the number of its correspondents. You will soon receive, I believe, a special letter on this subject, and I venture to hope that you will kindly accede to our wishes... ...I venture to hope that you will wish to honor me from time to time with your cards; If it is possible for you to communicate to me the meteorological observations that you made and will make during the years 1821, 1822 and 1823, I would be very happy to have them and that you would allow me to cite them in my works) (Larrañaga, 1924, p. 288).

Once again, Cuvier's name appears on the scene, but in a more categorical way since Louis Claude de Freycinet personally communicated Larrañaga's discoveries and analysis to Cuvier. In this way, the credibility generated in the studies of the native of Montevideo gained credibility in the Old World.

In this sense, on September 19th, 1822, Auguste de Saint-Hilaire wrote again to Larrañaga from Paris and, as Freycinet, indicated the following: "*...J´ai communique á notre savant Cuvier ce que vous me faites l'honneur de me mander relativement au Tatou fossil. Comme il se propose de donner bientôt une 2éme édition de son ouvrage, il désire vivement que vous publieez quelques chose sur cet objet intéressant, et me charge de vous en prier en son nom. Dans le cas ou cela ne vous convienddroit pas vous pourriez m´envoyer une simple note dont il profiteroit, en vous citant, comme cela doit être... ...Les nottes que vous m´aviez remises pour la Société Philomatique ne son point parvenues en France...*" (I have communicated to our sage Cuvier that you did me the honor of telling me regarding the fossil *tatú*. As he intends to publish a second edition of his work soon, he wants you very much to publish something about this interesting object and he asks me to do so on his behalf. In the event that this does not suit you, you could send me a simple note that he would use, quoting you as it should be done... ...The notes that you had sent me for the Société Philomatique did not arrive in France, and the same thing happened with a Memorandum that I had attached) (Larrañaga, 1924, p. 292).

DISCUSSION

The different passages of the chosen quotes not only highlight Larrañaga's work, but also show how different naturalists who came to the Río de La Plata ended up in one way or another recommending his studies. In particular, those referring *Megatherium* to George Cuvier, an international authority on natural sciences. It is possible to consider that Larrañaga's systematicity and eloquence, manifested in the different instances of interaction with other naturalists, led to a small part of his ideas on the classification of vertebrates being incorporated into one of the most important paleontological works of the 19th century.

At the moment, we cannot establish whether or not osteoderms assignable to *Glyptodon* or another glyptodon were collected with the *Megatherium* from Luján. The data cited here and historically contextualized allows us to

propose that its assignment to *Dasypus* is the result of Larrañaga's adherence to the methodological parameters established by the natural sciences at his time. To reduce his postulate to the consequences of a mixture of pieces would be to underestimate Don Dámaso's contribution to paleontological sciences.

The taxonomic decision made by Larrañaga regarding *Megatherium* is, in our opinion, the result of his analysis based on the information available for him and on the exchange of ideas and knowledge with other prestigious naturalists of that time. In this way, his work, referring to fossil vertebrates, takes on even greater prominence. Indeed, his study, based on the same characteristics proposed and used by Cuvier in his classification, led him to contradict Cuvier himself, this being manifested on different occasions, such as in the geological note transcribed above or in the letter sent to Bonpland in 1818. Larrañaga's dissent cannot be considered an unsubstantiated opinion. It arose from a detailed study of the objects and characters that reigned in the classification methods at that time.

The use of anatomical characteristics and their consequences in the classification of living beings was not a strange activity for Larrañaga as a naturalist or person of consultation. Among the recommendations that he sent to Father Muñoz (*vide supra*) to classify plants according to the Linnaeus's system, the presbyter remarked to Father Muñoz that he had to be very precise when recognizing the characters that these schemes included and supported. These recommendations also take place in the answers to the queries that different figures of that time made him and highlight the evidence regarding Larrañaga's concern for the systematics in observational and classificatory studies, and even, in the improvement of practices related to the generation and preservation of reference collections of living beings. These approaches that demarcate his attachment to the methods of the natural sciences of the early 19th century are what solidified his insertion in the fields of these sciences at a local and international levels. Larrañaga interacted both by letter and personally with the prestigious French naturalists Freycinet and Saint-Hilaire, and it is with them that he developed and shared his conclusions regarding *Megatherium*. Thus, we allow ourselves to reconstruct that in Montevideo at the beginning of the 19th century, Don Dámaso Antonio Larrañaga shared extensive talks, exposed his doubts, uncertainties, certainties, and resorted on more than one opportunity to exemplify his position and musings before French naturalists as a colleague, whose discrepancies should be respected just as Cuvier did when including his studies in his work.

CONCLUSION

More than 200 years have passed since Larrañaga decided to dedicate part of his time to the study of natural sciences. The analysis of his work allows us to establish that he was a naturalist whose method was consistent with those applied by other naturalists at that time. His studies related to the anatomy, taxonomy, and classification of living beings, with particular emphasis on living and fossil mammals, allow us to recognize Don Dámaso Antonio Larrañaga as the first great naturalist born and trained in the Río de La Plata, whose work, although mostly unpublished, marks the beginning of the vertebrate paleontology in the Río de La Plata from the transcendence of its systematic conclusions regarding the armored *Megatherium* included in the note published in Cuvier's work of 1823.

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ASOCIACIÓN PALEONTOLÓGICA ARGENTINA

FROM BURMEISTER TO AMEGHINO AND THE WORLDWIDE RECOGNITION OF THE VERTEBRATE PALEONTOLOGY FROM ARGENTINA

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Abstract. Francisco J. Muñiz was undoubtedly the first national Argentine paleontologist, preceding Florentino Ameghino with its pioneering descriptions of the fossil-bearing beds in Luján and their fossil mammals, including *"Muñi-felis*". In 1861, the German naturalist Hermann Burmeister (G. Burmeister, here after) arrived in Argentina to become the *Museo Público de Buenos Aire*s Director. G. Burmeister renovated the institution and founded the *Anales del Muse*o, one of the oldest Argentine scientific publications. In his last years, the *Museo de La Plat*a was consolidated under the leadership of Francisco Pascasio Moreno, who was the creator and served as its Director from 1884 to 1906. Under the direction of Moreno, the museum attracted eminent researchers, including F. Ameghino and his brother Carlos. When the Ameghino brothers left the institution, figures such as Alcides Mercerat and Santiago Roth replaced them. Roth became a key rival to Carlos in exploring Patagonian deposits with vertebrate fossils. F. Ameghino brought global visibility and *reconnaissanc*e of the Argentine paleontology due to his numerous publications based on the collections largely made by his brother Carlos and his appointment as the Director of the *Museo Nacional de Buenos Aire*s in 1902. After the death of Florentino, Carlos remained active at this museum, where a new generation of paleontologists emerged. Among them, Lucas Kraglievich stayed briefly in the *Museo de La Plat*a after the death of Roth. Then the Spanish mastozoologist Ángel Cabrera assumed as the Head of Paleontology, marking a notable stage in the Paleontology of Argentina.

Key words. Vertebrates. Mammals. Fossils. Argentine Paleontology.

Resumen. DE BURMEISTER A AMEGHINO Y EL RECONOCIMIENTO MUNDIAL DE LA PALEONTOLOGÍA DE VERTEBRADOS DE ARGENTINA. Francisco J. Muñiz fue sin duda el primer paleontólogo nacional, precediendo a Florentino Ameghino con sus investigaciones pioneras en Luján, con la observación de los terrenos fosilíferos y la descripción de algunos mamíferos fósiles, incluyendo "*Muñi-felis*". En 1861, el naturalista alemán Germán Burmeister arribó a la Argentina para asumir como el director del *Museo Público de Buenos Aires.* G. Burmeister renovó la institución y fundó los *Anales del Museo*, una de las más antiguas publicaciones científicas argentinas. Durante sus últimos años, el *Museo de La Plata* se consolidó bajo el liderazgo de Francisco Pascasio Moreno, quien fue el creador y sirvió como su director desde 1884 a 1906. El *Museo de La Plata* atrajo a múltiples renombrados investigadores, incluyendo a F. Ameghino y su hermano Carlos. Alcides Mercerat y Santiago Roth reemplazaron a los hermanos Ameghino, con Roth transformándose en el rival clave de Carlos en la exploración de los yacimientos de vertebrados fósiles de Patagonia. F. Ameghino, con sus numerosas publicaciones sobre las colecciones hechas por su hermano Carlos, y su nombramiento como director del *Museo Nacional de Buenos Aires* en 1902, dió a la paleontología argentina una visibilidad y reconocimiento mundial. Después del fallecimiento de Florentino, Carlos permaneció activo en el *Museo Nacional de Buenos Aires*, donde una nueva generación de paleontólogos emergió, entre los cuales Lucas Kraglievich realmente se destacó. En La Plata, luego de fallecer Roth, el mastozoólogo español Ángel Cabrera asumió la jefatura de Paleontología, marcando una notable etapa en la paleontología argentina.

Palabras clave. Vertebrados. Mamíferos. Fósiles. Paleontología argentina.

Since the earliest times of the Spanish conquest (*i.e.*, XVI-XVII centuries), fossil bones and teeth of great size were frequently found and commonly considered to be the remains of giants. During the late XVIII century, ending the colonial era, the discovery of the complete skeleton of the *Megatherium* in Luján made a turning point in the interpretation of these findings. It was recognized as an extinct giant mammal but related to the living sloths, raising an extraordinary interest in Europe in the remains of the fossil mammals found in Argentina. Despite this and except for the creation of a *Museo Público* in Buenos Aires, which housed among many natural history objects a few fossils, during the Independence period and part of the middle XIX century, there was no development of paleontological

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studies in the Argentine territory, making a difference to what happened in what is now Uruguay-formerly "*Banda Oriental*"-by Dámaso Antonio Larrañaga (1771–1848) (see Fernicola & Castiñeira Latorre, 2025).

Francisco J. Muñiz (1795–1871) was undoubtedly the first national Argentine paleontologist, preceding Florentino Ameghino (1853–1911) with its pioneering descriptions of the fossil-bearing beds in Luján and their fossil mammals, including "*Muñi-felis*". In 1861, the German naturalist Germán Burmeister (1807–1892; G. Burmesiter, here after) arrived in Argentina to become the Director of the *Museo Público de Buenos Aires*. G. Burmeister renovated the institution and founded the *Anales del Museo*, one of the oldest Argentine scientific publications. In his later years, the *Museo de La Plata* was consolidated under the leadership of Francisco Pascasio Moreno (1852–1919), who was the creator and served as its Director from 1884 to 1906. Under the direction of Moreno, the museum attracted eminent researchers, including F. Ameghino and his brother Carlos. When the Ameghino brothers left the institution, figures such as Alcides Mercerat (1869–1934) and Santiago (Kaspar Jacob) Roth (1850–1924) replaced them, with Roth becoming a key rival to Carlos in the exploration of the Patagonian deposits with vertebrate fossils. F. Ameghino, with his numerous publications based on the collections largely made by his brother Carlos and his appointment as the Director of the *Museo Nacional de Buenos Aires* in 1902, brought global visibility and *reconnaissance* of the Argentine paleontology. After the death of Florentino, Carlos remained active at the *Museo Nacional de Buenos Aires*, where a new generation of paleontologists emerged. Among them, Lucas Kraglievich (1886–1932) stayed briefly in La Plata after the death of S. Roth then the Spanish mastozoologist Ángel Cabrera Latorre (1879–1960) assumed as the Head of Paleontology, marking a notable stage in the Paleontology of Argentina.

FRANCISCO JAVIER MUÑIZ, THE FIRST ARGENTINE PALEONTOLOGIST

Francisco Javier Thomas de la Concepción Muñiz Frutos was an Argentine military medical doctor who, besides its contributions to medicine, deserves rightly the title of our first national paleontologist. Regarding his relevance, his first biographer was Domingo F. Sarmiento (1811–1888), in a volume (Sarmiento, 1885) prologued by Bartolomé Mitre (1821–1906) and F. Ameghino. Muñiz was Ameghino's immediate predecessor, as the latter recognized in his prologue, "*El se ocupó de las mismas que constituyen mis estudios predilectos, vivió quince años en donde Yo pasé mi niñez, y explotó los mismos yacimientos fosilíferos que Yo debía remover treinta años después y los recuerdos de sus hallazgos, vueltos populares en Luján, no contribuyeron poco a que me lanzara tras de él en las mismas investigaciones*" (He dealt with the same sciences that constitute my favorite studies, lived for 15 years where I spent my childhood, and exploited the same fossiliferous deposits that I had to remove thirty years later. and the memory of its discoveries, becoming popular in Luján, were not little to launch me after him into the same investigations) (Muñiz, 1953, p. 16).

Frequent discoveries of fossil bones in Buenos Aires city and its surroundings probably aroused the early interest of young Muñiz (Fig. 1.1). Assigned in 1825 to a troop cantonment at Chascomús, in Buenos Aires Province, in the lagoon ravines he found mammal fossils, such as a large armored xenarthran, mentioned by him as "*Dasypus giganteus*", probably a fossil dasypodid or perhaps a glyptodont. Years later, remains of a gigantic "*armadillo*" appeared in Uruguay, also named "*Dasypus giganteus*" by Vilardebó and Berro in 1838, in the Montevideo newspaper "El Universal" (Ottone, 2002). Curiously, in 1847, two friends of Muñiz annonimously claimed for him the paternity and priority of that species in the newspaper *La Gaceta Mercantil* (Palcos, 1943; Bond, 2001). So, despite limitations mainly related to the difficult political situation (long civil war between Unitarians and Federals), news on fossil discoveries circulated in the Río de La Plata society. Muñiz acted as a military surgeon in the war with Brazil, and back in Buenos Aires in 1828, married Ramona Bastarte Román (?–1868), settling at Luján, Buenos Aires Province, until 1848. On September 27, 1833, Charles Robert Darwin (1809–1882) passed rapidly through Luján on his journey to Santa Fé Province. He made a few geological observations but did not contact Muñiz since neither of them knew each other. In Luján, Muñiz began collecting in the banks and ravines of the Luján River and tributary streams, rich in Quaternary fossil mammals. In those years

appeared the book "Buenos Ayres and the Provinces of the Rio de La Plata...", written by Sir Woodbine Parish (1796–1882), a British diplomat in the Provinces of the Río de La Plata and sent by Great Britain to recognize the Independence of the Argentine Republic. Parish observed the geology of the "del Plata" area and its fossil mammals collecting some remains. In his book, Parish (1838) mentioned a new skeleton of *Megatherium* from "Luxán" (Luján) property of "Señor Muñiz", a doctor who extracted it with great care, being one of the first mentions of Muñiz as a cultist of paleontology. Also, Darwin (1846), citing the "British Packet of 1841", mentioned that "Dr. F. X. Muniz" collected in Luján many fossil mammals, probably "nine distinct species of mammifers" (Darwin, 1846, p. 106), showing that in those years, Muñiz possessed an important collection of fossil mammals.

In June of 1841, Muñiz sent a great part of his collection to the Governor of the Buenos Aires Province, Juan Manuel Ortiz de Rosas (1793–1877), who was also in charge of the foreign affairs of the "Confederación Argentina" or Argentine Confederation, former name of the Argentine Republic, probably by request of the latter or a personal gift of Muñiz to him, although this is still not clear. In an apologetic note, Muñiz wrote that having no teachers or books, nor any to consult or discuss his doubts, he surely committed errors or mistakes, asking the indulgence of Governor Rosas as he was a "*sabio*" (sage) (Muñiz, 1953). Muñiz sent 11 drawers with remains of megatheres, glyptodonts, mastodons, toxodonts, macrauchenias, and other mammals, mentioning the carpal bones of an "ourangoutan" (Muñiz, 1953), all coming from Luján and surroundings. Based on those supposed "ourangoutan" bones, Ameghino (1889), in his "*Suplemento*" (Supplement), commented that Muñiz probably was one of the first discoverers of human fossil remains in Argentina. However, perhaps following the ideas of his epoch, he did not believe in fossil man, so he attributed this remains to another primate as an "orangutan". Ameghino mentioned manuscripts of Muñiz describing these bones, probably those given to him by José M. Muñiz, F. J. Muñiz son. This mention of a supposed fossil primate represents a curious fact for Argentine paleoanthropology.

The attached documents in the envoy described the

Figure 1. 1, Young Francisco Muñiz by Carlos Enrique Pellegrini (modified from Palcos, 1943); **2,** Vice Amiral Jean Henri Joseph Dupotet (Jean Dupotet, 2025).

beds where they were found, the conditions where they could have lived (warmer climates), and how they were fossilized. Also, there are some commentaries on the mammal findings, pointing out that in one limb of a glyptodont, he observed a set of small bones that seemed to have been "*embutidos en las carnes del animal...*" (embedded in the meat of the animal) (Muñiz, 1953, p. 9), being one of the first observations on the small dermal ossicles present in extinct xenarthrans serving as protection. Muñiz included detailed instructions for extracting the bones and assembling the tail of a glyptodont, demonstrating his knowledge and concern for the conservation of these pieces. The collection was presented by the government of Rosas to Vice Admiral Jean Henri Joseph Dupotet (1777–1852) (Fig. 1.2), head of the French squadron at the Río de la Plata, as a gift for the ending of the French blockade on the River Plate. In 1846, Dupotet took the fossils to France, with many of them deposited at the National Museum of Natural History in Paris (*Jardin des Plantes*), arousing considerable expectation as we see in Darwin's letter written in 1847 to Richard Owen (1804–1892) (Darwin, 1847; Podgorny, 2011d). Some of those fossils were later figured—although not described—by the French zoologist Henri Marie Ducrotay de Blainville (1777–1850) in his volume from 1864 on the osteography of the mammals (Fig. 2.1) (Blainville, 1839–1864), whereas others were studied by the French naturalist Francois Luis Paul Gervais (1816–1879), who in 1855 described one of the first South American fossil bear "*Ursus*" *bonariensis* (*Arctotherium bonariense*, Soibelzon,

2004), based on a mandibular *ramus* and postcranial bones. Dupotet took some fossils of the Muñiz collection to the museum of Dijon (France), including a complete carapace, tail, and partial skeleton of a glyptodont later described and named by Léonard Nodot (1802–1859), Director of the Dijon Museum, as *Schistopleuron typus* (currently *Glyptodon reticulatus*). Dupotet's shipment promoted a debate about whether it did not represent a dispossession of the national heritage or was rather beneficial since the fossils were studied by European naturalists of prestige who increased the knowledge of our extinct fauna instead of remaining in a local environment with the difficulties highlighted in Muñiz's note heading the shipment. In this note, Muñiz stated the political circumstances of our country during the civil war and Rosas government, when people and institutions were subjected to political ups and downs, hence the praise for Governor Rosas as the "*Restaurador de las Leyes*" (Restorer of the Laws) (see Palcos, 1943). But the facilities for the extraction of fossils, which were afterward shipped out of Argentina granted by Rosas to Woodbine Parish agents, such as the collection gifted to Dupotet, were not accompanied by a similar effort to bestow the *Museo Público de Buenos Aires* with the quite frequent findings of fossil mammals. Being one thing a consequence of the other, we can only speculate that if the initial impulse of the May Revolution in 1810 and the effort of some authorities such as Bernardino Rivadavia (1780–1845) had continued, Argentina would surely have had institutions with adequate repositories for the fossil collections and access to bibliography where the Argentine native scholars educated under the tutelage of European professors could compare their findings. However, this did not happen, and Muñiz found himself isolated, without any other naturalist with whom he could discuss the anatomical characteristics, often unique, present in the fossils he discovered. As an assertion of this, in his brief description of the remains delivered, Muñiz inferred, based on erroneous evidence, the presence of horns in one extinct giant sloth (his "*megalonyx*"), realizing this mistake only after posterior findings. So, in September 1841, he published "A spontaneous self-rectification" in the *La Gaceta Mercantil*, a newspaper with mixed information of commercial, political, and general interest news, since the Argentine Confederation lacked a proper scientific publication, and the *Museo Público de Buenos Aires* languished due to lack of resources and personnel.

On October 9, 1845, the newspaper marked a milestone in the history of Argentine paleontology, as in number 6603 of the *La Gaceta Mercantil*, Muñiz published the description of an almost complete fossil skeleton of a feline carnivore he found at Luján (Fig. 2.2), a "saber-toothed tiger", which he named "*Muñi-Felis-Bonaerensis*", a self-referential name not used in science, but which according to Palcos (1943) would have been imposed by his friends. Muñiz remarked in the description that this type of animal had not been made known by the "*recomendable* Mr. Darwin" (recommendable Mr. Darwin) (Muñiz, 1953, p. 20), probably referring to Owen's "Fossil Mammalia" published between 1838–1840, with a geological introduction by Darwin. In this pioneering

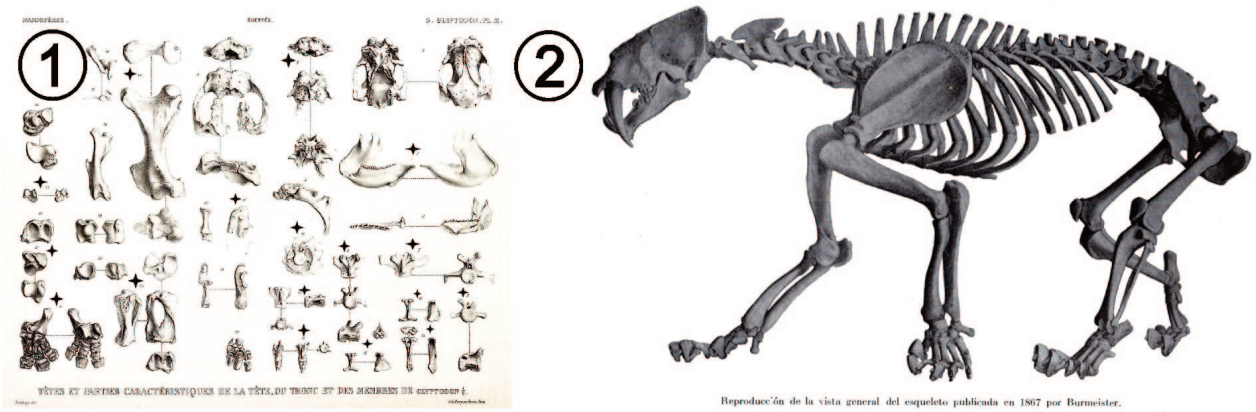

Figure 2. 1, *Glyptodon* (modified from plate 2, Blainville 1839–1864), stars indicate materials from the "Muñiz-Dupotet" collection; **2, *Muñi-felis***, from G. Burmeister (1868) but modified from Méndez Alzola (1941).

article for Argentine vertebrate paleontology, Muñiz gave a fairly detailed description (and a good table of measurements), using as reference the work "*del célebre* Mr. Cuvier" (of the famous Mr. Cuvier) (Muñiz, 1953, p. 39), referring to the book by the French naturalist Georges Cuvier (1769–1832), "*Recherches sur les ossemens fossils*..." of 1812, and others such as Félix de Azara (1742–1821).

Regarding the main anatomical features of this new felid, Muñiz commented on certain characteristics, such as the toothed edge of the canines, mentioning the similarities with a canine found in France of the extinct felid *Machaerodus*. Muñiz considered the skeleton could correspond to a female because the other calcaneum found, surely belonging to the same species, was much more robust. Muñiz also compared the adult skull of *Muñi-felis* to another skull of the same species belonging to a juvenile individual, pointing to its differences. He assumed the extinct felid as a great predator, and by analogy with the Yaguareté (*Panthera onca*), to be the natural enemy of the large extinct herbivores such as *Megatherium* and *Mastodon*, commenting that the "*Bonaerensis*" (*sic*) would be much larger and exceeding in fierce to other extinct felids such as the European cave lion "*Felis spelaea*".

In this contribution, Muñiz questioned the old idea of Buffon (Georges Louis Lecler de Buffon, 1707–1788) that there were no large American animals as in the Old World. It was becoming apparent that in the past, the American continent housed several gigantic-sized mammals that were now extinct, as Thomas Jefferson (1743–1826) had thought. Jefferson was a former critic of Buffon's opinion on the size of American mammals. However, based on erroneous evidence since Jefferson described his *Megalonyx* as a giant North American carnivore based on a big-sized ungual phalanx, later demonstrated to belong to an extinct giant ground sloth (Simpson, 1984; Bond, 2001). Finishing the *Muñi-felis* article, Muñiz apologized for any mistake made since he found himself "*aislado de toda relación que pudiera ilustrarme*" (isolated from any relationship that could enlighten me) (Muñiz, 1953, p. 43), something similar to what he wrote in the accompanying note of the collection sent to Rosas. Sometimes, Muñiz's isolation has been considered an imposture (Podgorny, 2011d, but see Feijó & Vizcaino, 1999), presenting himself as lacking references while classifying the fossils citing Cuvier and Owen; it is clear that Muñiz mentioned this literature because he owned or had access to it; what he meant by his isolation was that he lacked an interlocutor to discuss the many doubts that those findings generated. The skeleton of *Muñi-felis* was later referred to the genus *Smilodon* as *S. bonaerensis* (Muñiz, 1845), currently a synonym of *Smilodon populator* Lund, 1842 (Burmeister, 1868; Méndez Alzola, 1941; Forasiepi *et al.*, 2007). Probably due to economic difficulties, the *Muñi-felis* skeleton was offered for sale, at least on one occasion to Darwin (Darwin, 1847; Muñiz, 1953; Podgorny, 2011d), but remained in Argentina and ended up being donated to the *Museo Público de Buenos Aires*. In 1845, Muñiz requested, through a letter to Governor Rosas, to be officially granted the privilege of being the only explorer of the fossiliferous deposits of the Luján River within a perimeter of one league (*ca.* 5 km) around the town. The reason for this request was that his discoveries had taught many people how to get to the fossils, and some having time and resources that he did not have, would anticipate him in new discoveries. However, the note was unanswered (Palcos, 1943).

The epistolary contact between Muñiz and Darwin is well known, as the latter was very interested in the strange cow mutation called "*vaca ñata*" on which Muñiz gave valuable information. In a letter dated 1847, Darwin told Muñiz that the saber-toothed tiger he discovered could represent the genus *Machaerodus*. Noticing Muñiz's apparent intentions to give away the saber-toothed remains, Darwin wrote to Owen that same year, attempting to achieve the magnificent acquisition of the *Machaerodus* specimen. Finally, in another letter of 1847, Darwin confirmed to Owen that Muñiz was still interested in offering the skeleton of the saber tooth among other remains such as *Megatherium*, believing Muñiz's fossil felid would look magnificent in a montage compared to the skeleton of a recent tiger. Darwin also asked Owen about the fate of Dupotet's fossils arrived in Paris. According to certain sources, after several negotiations, there was an intention to offer Muñiz 100 sterling pounds, a very profitable sum (nearly 12,793 current pounds or US$ 15,399), but the transaction did not take place, and the *Muñi-felis* skeleton stayed in Buenos Aires (Darwin, 1847; Barcat, 2009; Podgorny, 2011d) At the time,

Muñiz finished his Topographical notes, describing the sedimentary layers observed in the Pampean terrains of Buenos Aires Province, with the superficial layer of "*humus*", then whitish post-Pampean chalk, deposited in lowlands and small ravines or "*cañadas*", followed by the Fossiliferous Terrain formed by a yellowish marl bed, where the majority of the fossil skeletons were found (currently known as Lujanian beds, upper Pleistocene), followed by layers of pebbles or coarse sand and then, ferruginous marl (probably the red Pampean or Bonaerian). On the genesis of the fossiliferous terrain, Muñiz made original taphonomic observations (Muñiz, 1953). The positions of the skeletons found—many of them complete—indicated that those mammals died in swamps or ancient lagoons, in some cases exhibiting evidence of the efforts to escape from the swamp traps. Muñiz inferred a slow oscillation of the sea covered the fossiliferous sites with silt. Accounting for the marine beds observed in the Patagonian and the Mesopotamian areas, he deduced that the great Pampas basin had a very remote origin, speaking of cretaceous substances and planetary attractions as a possible cause for the crustal oscillations and sea advances. Even if not fully correct, this shows that Muñiz was a keen observer of the geology and paleontology of the Pampean beds.

As mentioned, two friends of Muñiz claimed for him the priority on the naming and discovery of the "*Dasypus giganteus*" in a note to "La Gaceta Mercantil" (1847). They presented themselves as two federals, friends of justice, in an ominous confession of political faith, clearly showing the troublesome situation, not precisely favorable for discussing fossil species (Palcos, 1943).

In 1848, Muñiz settled in Buenos Aires, and after Rosas was overthrown (1852), Muñiz served the Buenos Aires Province with active participation in civil war battles (*i.e.*, Cepeda battle, 1859, where he nearly lost his life attending a wounded soldier), as a military doctor (he retired as with colonel), in politics as a senator, and from 1855 to 1862, as the Dean of the Faculty of Medicine. As a consequence of a cultural revival, the "*Asociación de Amigos de la Historia Natural del Plata*" (Friends of Natural History of the Plata Association) was created in 1854 to help the *Museo Público de Buenos Aires* (Public Museum of Buenos Aires), with Muñiz as one of its founding partners. In 1857, he donated several fossils to the museum, including part of the lower jaw of the same fossil bear given to Rosas, a complete skull of *Toxodon*, parts of the skull of a fossil horse (*Hippidion*), and a curious petrified tree that adorned the front of his house in Luján.

Urged by economic necessities, in 1860, Muñiz sold a series of fossil remains, including a *Smilodon* skull, to Stockholm, receiving various honors (Knight Cross of the Order of Wasa) from King Charles XV (1826–1872) of Sweden. In 1866, he approached the newly founded "S*ociedad Paleontológica de Buenos Aires*" (Paleontological Society of Buenos Aires). During the Paraguayan war (1865–1870), despite his age, Muñiz served as chief surgeon in the army, retiring as professor and doctor in 1869. Unfortunately, during the yellow fever epidemic of 1871, on April 8, he died while caring for a patient of said epidemic, thus disappearing who deserves, with justice, the title of the first national Argentine paleontologist. Although standing as an isolated figure and beyond the limitations and problems he faced, Muñiz deservedly was a correspondent with Darwin, biographed by Sarmiento, respected by G. Burmeister, and revindicated by F. Ameghino as his predecessor in the knowledge of the geology and paleontology of the Luján area. As a result, Muñiz stands out as a pioneering figure for the Argentine mammalian paleontology, an enlightened person in an epoch obscured by the political circumstances.

Since 1852, once Rosas fell, the new authorities of the "*Confederación Argentina*" (Argentine Confederation) and Buenos Aires showed a renewed interest in the study and exhibitions focused on the natural sciences, but politics would once again influence the fate of the institutions dedicated to the natural sciences. After Rosas was overthrown, General Justo José de Urquiza (1801–1870), stood as the political leader and provisional Director of the Argentine Confederation. However, on September 11, 1852, Buenos Aires rose against Urquiza, separating from the other provinces and the Confederation.

In May of 1854, the pharmacist Santiago Torres (?–?) replaced Antonio Demarchi (1822–1879) as the Director of the *Museo Público de Buenos Aires* (Public Museum of Buenos Aires), staying in charge until 1861. Probably by the suggestion of S. Torres, the government endorsed the

constitution of an association to help the museum, which is still at the convent of Santo Domingo in Buenos Aires. Thus, on May 6, 1854, the association "*Amigos de la Historia Natural del Plata*" was created to increase and protect the museum. A few founding members were related to paleontology; one was Muñiz, another was Manuel Ricardo Trelles (1821–1893), the main promoter of the association (Asua, 2012) and who was very interested in various topics, and Friar Manuel Torres (1750–1817?/1819?). Close ties with the University of Buenos Aires, whose Rector José Barros Pazos (1808–1877) was a member of the association, contributed favorably to the *Museo Público de Buenos Aires* as it was removed between 1854 and 1857 from the convent of Santo Domingo to an old building in the former Jesuitic block, where the University of Buenos Aires had been operating since 1821. The block is known as the "*Manzana de las Luces*" ("Enlightened block") (Asua, 2012), a name traditionally given to the temple of San Ignacio and surroundings, referring to the site where the "enlightened" people interested in culture and sciences met since colonial days (Camacho, 1971), and where many cultural institutions concentrated, as clearly expressed in the newspaper "El Argos de Buenos Ayres" (September 1, 1821).

POLITICAL AFFAIRS AND THE COMING OF BURMEISTER

Separated in 1853 from the Argentine Confederation, Buenos Aires Province returned to it triumphally after the battle of Pavón in 1861. In consequence, in 1862, Paraná was replaced by Buenos Aires as the capital of the Confederation, where the powerful and conflictive political relationship between provincial and national governments unexpectedly interfered with the natural history museums. Undoubtedly, the arrival of G. Burmeister to Argentina marked a decisive turn for the Argentine vertebrate paleontology. Despite criticisms received, especially for the somewhat severe treatment of his contemporaries, he transformed the *Museo Público de Buenos Aires* from almost a cabinet of curiosities into a museum of natural sciences, also editing the first Argentine scientific publications on the subject. It is difficult to synthesize the extraordinary scientist who came to Argentina in the figure of G. Burmeister. We will say that Karl (Germán) Hermann Konrad Burmeister was born on January 15, 1807, in Stralsund, the capital city of Western Pomerania, a German territory traditionally under Prussian influence. An excellent scholar, G. Burmeister studied at Halle University (Saxony) and graduated in 1829 from the Faculty of Medicine and Philosophy. Primarily interested in entomology, he wrote a thesis on a natural system classification for insects, and in 1837, he was appointed professor of zoology at Halle University. He married Marie Elise Sommer in 1836 and had two sons, Heinrich and Hermann. The latter would become a companion to his father on some trips, living in South America between 1857 and 1888 before returning to Europe, whereas Heinrich remained with his mother (Birabén, 1968; Ulrich, 1972; Mantegari, 2003). The scientific production of G. Burmeister in its German period is extraordinary and diverse. Superb entomologist, he published a Manual of Entomology in five volumes (1832–1855), which became an international reference book among specialists and was translated into English (Ulrich, 1972). In 1843, he published the first edition of his notable book, "History of the Creation. A representation of the development of the Earth and its inhabitants. For the educated of all classes" attaining enormous success with eight editions in german (1843–1872), and several translations. Besides the general public, this work enjoyed great esteem among great scientists such as Alexander von Humboldt (1769–1859). In 1848, G. Burmeister briefly ventured into politics, participating in the revolutionary movement of 1848 and becoming Deputy for Liegnitz, Silesia, Prussia (now Legnica, Silesia, Poland). Not agreeing with certain political practices and not betraying the ideals of his voters, he resigned from the seat in 1850. Faced with new setbacks, marital problems, and confrontation with the Prussian educational authorities. Through Alexander von Humboldt, G. Burmeister obtained a leave of absence from the university and a royal subsidy to visit Brazil. He had long wanted to visit Latin America to study its fauna and consider the possibility of settling there. On September 12, 1850, G. Burmeister headed to South America, visiting several locations in Brazil. In 1851, he suffered an accident at Lagoa Santa, famous for its caves with fossil mammals, and explored by naturalists such as the Danish Peter Wilhelm Lund (1801–1880), who was considered the father of Brazilian paleontology. On his farm, G. Burmeister was

treated for a fracture in his right leg, an injury that bothered him for the rest of his life. After 19 months in Brazil, he returned to Europe. In 1856, he traveled again to visit the Plata basin at the suggestion of von Humboldt.

On his way to South America, G. Burmeister passed through Paris, where he met the Argentine Juan Bautista Alberdi (1810–1884), a former "*emigré*" as an enemy of Rosas but who was at that time Minister of the Argentine Confederation before the French Empire of Napoleon III (1808–1873).

Knowing the scientific importance of G. Burmeister and the benefits his trip would bring to the knowledge of these regions, Alberdi gave G. Burmeister on September 22, 1856, a recommendation letter for General Urquiza, then president of the Confederation, expressing that G. Burmeister was on a special mission sponsored by the King of Prussia, Frederick William IV (1795–1861), to study Mendoza Province and that his visit would help to know the richness "*de que somos por ahora poseedores inconscientes*" (we are currently unconscious possessors) (Birabén, 1968, p. 15). G. Burmeister left Southampton, England, on October 9, 1856, arriving in Rio de Janeiro (Brazil), where he stayed with the German doctor and naturalist Robert C. B. Avé-Lallemant (1812–1884). He later continued his trip to Uruguay in December 1856, where he made some paleontological collections. On January 31, 1857, he arrived for the first time in Buenos Aires city, being very impressed by its edifices, such as the new landing dock and the almost finished new Custom House. While visiting the *Museo Público of Buenos Aires*, G. Burmeister commented that it was still underdeveloped. However, with a vigorous push and the "treasures" (fossils) buried in the surroundings of Buenos Aires, it would reach a high rank amongst the museums, an almost premonitory statement (Birabén, 1968). Regarding the wealth of the fossil mammals found there when talking with the French naturalist Auguste Bravard (1803–1861), G. Burmeister mentioned his intention to seek fossil vertebrates in the "*toscas*" (Ensenadan, Pleistocene) of the Río de la Plata, in Buenos Aires city and its surroundings. Bravard considered that the expeditions in these "*toscales*" were challenging after the experiences of his French colleague and collector Francoise Seguin (1812–1878). Despite the warnings, G. Burmeister went on a collection trip to the "*toscales*", but only gathered a few remains (Burmeister, 1876). Fortunately, the "*toscales*" fossil wealth had not been exhausted, and many vertebrates could be collected before they almost disappeared due to modern urbanization (Soibelzon *et al.*, 2008). G. Burmeister went to Rosario (Santa Fe Province) and Paraná (Entre Ríos Province), receiving documentation to travel through the Confederation. G. Burmeister was well-impressed by Paraná, the Argentine capital at that time, with a notable commercial and intellectual movement. In Paraná was the *Museo del Paraná*, a scientific museum expectedly rival of the *Museo Público of Buenos Aires*, with Bravard as the Director. Due to his intransigent manners, G. Burmeister faced some problems, so the Consul of Prussia and friend, Freiherr Friedrich Hermann Herbert von Gülich (1820–1903), wrote to Juan María Gutiérrez (1809–1878), then Minister, to help the German scholar and attributing G. Burmeister's harsh conduct and brusque character to personal troubles (Mantegari, 2003). After visiting Mendoza Province and other areas, G. Burmeister returned to Paraná, where he attended a military parade for the celebrations of May 25, 1858, and was so well-impressed with it and the gala ball that he felt for a moment in a solemn ball in Berlin or the court of one of the small German principalities (Borello, 1973). When in Paraná and Santa Fé, G. Burmeister made observations on the geology of the Paraná cliffs and the Pampean in the Salado area. Then G. Burmeister attempted to become the rural owner of a farm near Paraná (from September 1858 to June 1859) with his son Hermann, after which he sold the property and sent his collections to Hamburg, Germany. G. Burmeister destiny was not to be a farmer but to stay, fortunately for us, a scientist. Then, he visited Córdoba, Tucumán, and other northwestern provinces, feeling very comfortable (Birabén, 1968) and taking notes on natural history, ethnography, and archaeology. As the brilliant draftsman he was, he made many sketches, including those of the old city of Mendoza before it was completely destroyed by an earthquake on March 20, 1861 (with Bravard as one of its victims), so the views G. Burmeister took have a notable documentary value.

Crossing the Andean Cordillera in a voyage that can be described as a heroic deed, G. Burmeister arrived in Chile,

then Perú, Panamá, and finally to Europe, reaching there on May 12, 1860 (Birabén, 1968). This trip resulted in Burmeister's book "*Reise durch die La Plata-Staaten*..." ("Journey through the states of La Plata..."), edited in two volumes in Halle (Germany) in 1861, with observations on the places visited, the people, costumes, ethnographical and archaeological notes, including his sketches and those made by his adjutant Anton Goering (1836–1905). A magnificent work, G. Burmeister's "journey" book alone would credit him as more than a remarkable chronicler for Argentina. As a professor in Halle, he immediately collided with the new ordinances for medical students that reduced the number of assistants to G. Burmeister classes, so on March 1861, he resigned his position as a professor and divorced his wife, returning to South America. He expressed his feelings of comfort in Argentina in the second volume preface of the "Journey to the States of del Plata", where he also stated he was going to dedicate himself to scientific research in the Plata region for the rest of his life (Mantegari, 2003). G. Burmeister was aware of the offers made to Bravard to be in charge of the Museum of Buenos Aires, precluded by his unexpected death. So, G. Burmeister wrote to the consul Freiherr von Gülich as an intermediate in his offer to be Director of the Museum of Buenos Aires to the then Governor of Buenos Aires, Mitre, and his minister, Sarmiento. As one of the most renowned European naturalists, G. Burmeister's outstanding production between 1829 and his coming to Argentina in 1861 comprises at least four books on Natural History, including the renowned "Natural History of Creation", four books on general zoology, 12 on geography and geology articles and books including "Journey to the States of del Plata", three on Climatology, 23 works on Mastozoology (including the magnificent monography on *Tarsius*), Ornithology, Herpetology and Carcinology, 40 entomological papers, and the "Treatise on Entomology". On paleontology, 12 works on varied groups, such as the one on Trilobites from 1843, became a classic translated into English in 1846. He also wrote on fossil cetaceans, amphibians ("stegocephalians" or "labyrinthodonts"), and reptiles, especially one on a fossil marine gavial-like crocodile, that he compared with living and fossil ones, recommending that before describing new species, paleontologists should take account on the individual variations (Ulrich, 1972). A skillful anatomist, he was well-acquainted that morphological variations observed in fossils could indicate age or sexual variations and not necessarily characters that justified the naming of new species. He was an excellent designer, and many of his works were illustrated by him. It is important to remark that G. Burmeister was not a creationist; his book "History of Creation", has no connection with the biblical one, and references of G. Burmeister to the *Diluvium* or "flood", were due to the old geological term for Quaternary sediments and the extinct fauna, and not by acceptance of a biblical inundation. With regards to the evolution topics, Burmeister believed that biological diversity originated in steps of increasing complexity and the progression, including man, had reached its culmination, an idea probably related to the transformation changes or metamorphosis developed by the Natural Philosophy of Johann Wolfgang von Goethe (1749–1832). G. Burmeister was not, at least publicly, a "Lamarckist" or "Darwinist" because he did not agree with the explanations proposed by these authors for the transformations that occurred in this increasing complexity or evolution through time. In G. Burmeister words: "*ich glaube nicht an die Umbildung der Species. Welche manchr Naturforscher lehren*" (I do not believe in the transformation of species taught by some naturalists) (Ulrich, 1972, p. 2). So, by 1861, with at least 119 titles published (Birabén, 1968; Ulrich, 1972), we got an idea of who the extraordinary naturalist coming to Argentina was and after his arrival, he signed his works and was known to the people in Argentina as G. Burmeister.

G. Burmeister arrives to Argentina

G. Burmeister's offer to be in charge of the *Museo Público de Buenos Aires* (Public Museum of Buenos Aires) was well received by Sarmiento, who invited him to travel as soon as possible. Sarmiento, as well as other Argentine politicians like Urquiza, was interested in investigating the natural resources of Argentina, especially those related to geology and mineral resources, and the future economic impact on the development of the Confederation. G. Burmeister arrived in Buenos Aires on September 1, 1861, a few days before the battle of Pavón (September 17), the event of decisive significance as the "defeat" of the national troops

by the Buenos Aires ones. This generated a profound political crisis and the resignation of the then President of the Confederation, Santiago Derqui (1809–1867), with Mitre, Governor of Buenos Aires, as his successor, and from 1862, formal President of the Argentine Confederation, and the definitive national unification with Buenos Aires as prevailing power. Consequently, Paraná lost importance as the former capital of the Confederation and also its National Museum, as the political power moved to Buenos Aires, where the old Public Museum was. After some dilations, Sarmiento urged Mitre to make the nomination of the German naturalist effective, so he could begin his studies at the museum in Buenos Aires, curiously stating, "in order to undertake precious studies that give rise to some rare fossils" (Mantegari, 2003). On February 21, 1862, G. Burmeister replaced S. Torres as the General Director of the *Museo Público de Buenos Aires* at the "*Manzana de la Luces*" (in Perú street), where he stayed from 1862 to 1892. By then, at 54 years old, G. Burmeister was a mature but energetic man, developing an intense activity over the 30 years he stayed in Argentina, having a great production, especially on Quaternary fossil mammals of the *"pampas"* (Fig. 3.1–2). As the Director of the *Museo Público de Buenos Aires*, G. Burmeister (who signed many articles under his Spanish name Germán) transformed the by-then not-very relevant and decayed provincial museum into an organized and growing institution, becoming the *Museo Nacional*. Despite being in Argentina, G. Burmeister did not cut ties with his homeland, publishing many articles through Halle University. In his personal life, G. Burmeister added an important tie to Argentina by marrying a Tucumán lady, Petrona Luisa Tejeda Reynaga (1843–1907) and by having another four sons, of which Carlos Germán Venancio Burmeister (1867–?; C. Burmeister, here after) and Federico Alberto Andrés Burmeister (1874–1965, F. Burmeister, here after) aided him as auxiliaries or traveling naturalists at the Buenos Aires and the La Plata museums. As he previously did in Germany and Argentina, G. Burmeister worked in many fields. However, he made his most notable contributions on vertebrate paleontology and the Pampean fossil mammals, making him a reference in the field.

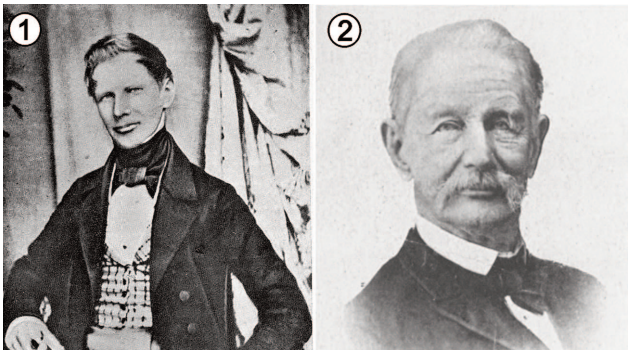

Figure 3. 1, Young G. Burmeister; **2,** Old G. Burmeister (both pictures were taken and modified from Birabén, 1968).

Although almost exclusively attending the *Museo Público de Buenos Aires*, from 1870–1871, G. Burmeister was appointed to Córdoba Province by Sarmiento, then Argentina's President and his Minister Nicolás Avellaneda (1837–1885) as Commissioner for the organization of a Faculty of Sciences in the Universidad Nacional de Córdoba (National University of Córdoba), and also in 1873, appointed again as Scientific Director of the *Academia Nacional de Ciencias* in Córdoba Province (National Academy of Sciences), but this time staying in Buenos Aires Province. For these tasks, G. Burmeister convoked a large group of German professors, who ended up being considered very important to the scientific development in Argentina. However, he would leave Córdoba in 1875 due to diverse disagreements with his colleagues (Mantegari, 2003). G. Burmeister promoted the creation of a "*Boletín de la Academia de Ciencias*" (Bulletin of the Academy of Sciences in Córdoba), which became an important scientific journal for Argentina. After this interval in Córdoba, G. Burmeister devoted himself entirely as the Director of the *Museo Público de Buenos Aires*. He was very fond of the institution, expressly writing that he loved it (Burmeister, 1870–1874).

Officially respected and supported by many, G. Burmeister was also sometimes criticized by young foreign and Argentine scientists (*i.e.*, Doering, F. Ameghino, Holmberg, and sometimes Moreno), who were upset by his intransigence and often not very pedagogical attitudes. Even at his age and suffering physical difficulties, in 1884, he went to Entre Ríos and Corrientes to examine fossils at the Paraná River cliffs (see Mantegari, 2003), some of them shown to him by Professor Pedro Scalabrini (1848–1916) of the *Escuela Normal de Paraná* (Burmeister, 1885). Honored on the 50th anniversary of his doctorate by many

personalities in Buenos Aires, G. Burmeister also had many *reconnaissance* such as the Cross of the Order of the Crown by the King of Prussia Wilhelm I (1797–1888) and the Order of the Rose by the Brazilian Emperor Dom Pedro II (1825–1891) (Birabén, 1968; Casinos, 2012). The Order of the Rose was conceded by donating to the Museum of Rio de Janeiro (Brazil) of the skeleton of an extinct giant ground sloth *Scelidotherium*, from the Quaternary of Argentina. At 79 years old, in 1886, G. Burmeister went to Rio de Janeiro and supervised the skeleton mounting, which was viewed and admired by Dom Pedro II (see Lopes, 2000; Mantegari, 2003). Also, in 1890, at 83 years old, G. Burmeister went to Italy, returning from Genoa in August 1890 (Burmeister, 1883-1891), which speaks of the indomitable energy of this man. Independent and making himself many things at the museum, this sometimes caused him dangerous troubles (see Birabén, 1968), as on June 6, 1870, when he surprised an infidel employee stealing at the museum and was seriously beaten by it; also on February 8, 1892, while trying to shut a window he fell from a stair and wounded severely, thus forcing his retirement from the museum and ultimately causing his death on May 2 of the same year at his house in Buenos Aires (Belgrano and Cevallos streets).

Before his demise, G. Burmeister suggested Carlos Berg (1843–1902), then at the *Museo de Montevideo* (Uruguay), be appointed as the Director of the *Museo Nacional*. Honored by the principal authorities, such as the then-President Carlos Pellegrini (1846–1906), G. Burmeister's passing concluded a historical stage of what can be considered the beginning of Argentine vertebrate paleontology.

G. BURMEISTER AND HIS LEGACY

The Museum

G. Burmeister took over a museum that was a mix of natural science objects (minerals, animals, plants, and fossils) and historical ones (numismatic, medal collections, mummies) (Burmeister, 1864–1869), transforming the *Museo Público de Buenos Aires* into a real natural history establishment. He managed all the natural history objects in the museum. G. Burmeister was aware of the importance of the Pampean fossil mammals and its significance for the museum, given the scientific value and the interest it generated to visitors and general public, as stated in the preface ("Proemio", Burmeister, 1864–1869) of the first volume of the *Anales del Museo Público de Buenos Aires*, "*El suelo de la Provincia de Buenos Aires es conocido largo tiempo ha en el mundo científico como uno de los depósitos más ricos de huesos fósiles en la superficie de la tierra*" (The soil of the Province of Buenos Aires is long time known in the scientific world as one of the richest deposits of fossil bones on the surface of the earth) (Burmeister, 1864–1869, p. 3). Many of these fossils were taken to museums in Europe, but others of great scientific value were preserved in the *Museo Público de Buenos Aires*, an establishment "*casi desconocido tanto en Europa como en América por falta de comunicaciones públicas sobre sus riquezas depositadas*" (almost unknown both in Europe and in America due to the lack of public communications about its deposited wealth) (Burmeister, 1864–1869, p 3). For G. Burmeister, the fossil richness of the territory had to be protected, kept at the museum, and developed into an official scientific publication to make the scientific research at the *Museo Público de Buenos Aires* known, both for scientists and the general public of Europe and other places of the Americas. A defender of the autonomy of the museum, G. Burmeister maintained a sometimes conflictive relation with Gutiérrez, Rector of the University of Buenos Aires during 1861–1878, who considered the museum under his jurisdiction, by a decree, December 5, 1862, of the Governor of Buenos Aires, Mariano Saavedra (1810–1883), subordinating the by then provincial museum to the university, G. Burmeister considered that he depended directly on the Higher Government and not the Rector of the university. Finally, Gutiérrez warned G. Burmeister that the museum was part of the university but gave him freedom in making decisions and autonomy for the museum. In complex situations, G. Burmeister also had almost unconditional support from Sarmiento, a powerful and influential political figure with a high esteem for the scientific capacity of the Prussian sage. To make a true natural history museum, G. Burmeister took special care in the exhibition of the materials, preparing shelves, cabinets, and pedestals according to models he brought from Halle, with the economic support of the provincial government (Burmeister, 1864–1869). After its arrival, he was devoted to the mounting and restoration of the carapace and skeleton of a *Glyptodon* stored in the collection, finishing it

with success and recognizing the efforts made by the technician of the museum (Burmeister, 1883–1891). He incorporated many important and invaluable natural science objects, especially those related to vertebrate paleontology. Bravard's collection had valuable specimens such as the skull and mandible of *Macrauchenia patachonica* from Arrecifes (Buenos Aires Province), the skull of the gigantic bear *Arctotherium latidens* from Ensenadan beds near the city of Buenos Aires, and fossils from Tertiary beds of Paraná, amongst other pieces. The museum acquired other fossil mammals, such as magnificent specimens of glyptodonts and giant sloths such as a *Mylodon*, and also received donations, including a magnificent fossil dolphin skull of *Saurodelphis argentinus* from the Miocene of Entre Ríos Province. In addition, G. Burmeister acquired for the museum a complete specimen of the fossil equid *Hippidion* found near Luján by the Breton brothers and the extraordinary skeleton of the "*Muñi-felis bonaerensis*", the saber-toothed tiger described by Muñiz, currently named *Smilodon populator*, which was donated to the museum by the North American railroad entrepreneur William Wheelwright (1798–1873) (Palcos, 1943). G. Burmeister managed to double the budget of the institution, which allowed him to increase the number of employees, integrating the staff for a brief time (1866–1868) with the famous Italian taxidermists Antonio Pozzi (1822–1898) and his son Santiago (1849–1929) (Lascano González, 1980; Mantegari, 2003; Farro, 2009; Miñana & Martinelli, 2022). Being G. Burmeister a figure worth of consideration, the provincial Senator José Hernández (1834–1886), the author of the Argentine national poem "*El Gaucho Martín Fierro*" (The Gaucho Martín Fierro), intervened personally obtaining a new employee for the museum, arguing that the paleontological richness of the province had to be protected from those who take the fossils to Europe obtaining a great profit, and citing as examples the collection of fossils made in Mercedes by Ameghino that had been sold for 100,000 francs, and the important collection that "Santiago Rut" (Santiago Roth) sold to Copenhagen (Denmark). Hernández remarked that the sage G. Burmeister was a first-category scholar of universal importance and the *Museo Público de Buenos Aires* paleontological wealth was (and here Hernández probably exaggerated on purpose) one of the firsts in the world (Bond, 2019). Above all this, G. Burmeister demanded salary increases not only for himself but for his employees and kept asking for more space, sometimes at the expense of the edifice of the Universidad de Buenos Aires at the "Manzana de las Luces" (see Mantegari, 2003). Undoubtedly, the efforts of G. Burmeister made the Museum of Buenos Aires a well-known Argentine scientific institution among both local and foreign visitors and scientists, as in 1872, the young Belgian naturalist Édouard van Beneden (1846–1910), son of the zoologist and paleontologist Pierre J. van Beneden (1809–1894), visited the museum and spoke highly of the fossils exhibited as precious materials, recognizing that the progress of the museum was mainly due to the activities of G. Burmeister, but with an important support from the provincial government of Buenos Aires (Governor Mariano Acosta, 1825–1893). Van Beneden considered that the paleontological collections of Pleistocene fossil mammals exhibited at the Museum of Buenos Aires were *on par* with many European museums. Such an exhibition was possible because of the continued incorporation of Quaternary fossil mammals, those from the Tertiary of Paraná, others from Monte Hermoso (Buenos Aires Province), and only a few collected in Patagonia, since the *Museo Público de Buenos Aires* did not have the same resources as the La Plata Museum, when under Moreno directive systematic collecting campaigns in Patagonia began (see Mantegari, 2003). Some fossils from Patagonia were brought by his son C. Burmeister and others by the explorer Ramón Lista (1856–1897), whom G. Burmeister guided.

Protection of the fossils: pioneering efforts of G. Burmeister

The fossil richness of the Pampas region awoke—since the beginnings of the XIX *siècle*—a fossil fever where many collectors extracted and sold unique specimens to European museums, obtaining juicy profits (Podgorny, 2011a, 2011b, 2013; Toledo, 2021b). This impoverished the national paleontological heritage, further disadvantaging the local museums. Clearly aware of this, G. Burmeister decided to apply to the governmental authorities of Buenos Aires Province, accomplishing the issue of a decree dated April 14, 1863, and signed by Governor Saavedra and its Minister

Acosta, prohibiting the extraction of fossils without the government's permission. The decree also established that those materials extracted without permission would be confiscated and deposited in the *Museo Público de Buenos Aires*, where the fossils extracted with permission should onwards be stored. Although not totally effective, this decree is clearly the immediate antecedent of the subsequent national laws of paleontological protection 9080 (1913) and 25743 (2003), making G. Burmeister one of the pioneers in Argentina of paleontological protection.

The Paleontological Society of Buenos Aires, a magnificent, short-lived intent

Besides official support, the old "*Asociación Amigos de la Historia Natural*" (Friends of Natural History Association) did not satisfy G. Burmeister as an effective aid to produce the Argentine scientific publications needed. So, in 1863, G. Burmeister, in rather discourteous terms, requested the resignation of S. Torres, former Director, professor of natural history, and promoter of the association, and dissolved it. Despite its apparent ineffectiveness, the dissolved association left substantial money as a legacy (see Mantegari, 2003). In 1866, the new *Sociedad Paleontológica de Buenos Aires* (Paleontological Society of Buenos Aires) was created, becoming the first paleontological association in Latin America. This new Society began with the best auspices, its members being politicians, professors, merchants, *etc*., and inextricably linked to the official sphere since its President Gutiérrez was Rector of the then provincial Universidad de Buenos Aires, the Scientific Director was G. Burmeister. Among its partners, the Society had many influential citizens, such as Marcos Paz (1811–1868), Argentine Vice President, who exercised the presidential function as President B. Mitre was at the military command in the war against Paraguay; Guillermo Rawson (1821–1890), Minister of the Interior; Eduardo Costa (1823–1897), Minister of Justice and Public Instruction; Pastor Obligado (1818–1870) and Saavedra (politicians and former Governors of Buenos Aires); and many other personalities, including the Italian Pellegrino Strobel (1821–1895), one of the first geology professors at the *Universidad de Buenos Aires*. A few scientific associations, especially paleontological ones, could probably show members so closely related to political power as the Paleontological Society of Buenos Aires.

In its statute, the first article established that *La Sociedad Paleontológica de Buenos Aires se forma por libre unión de los Socios fundadores y con aprobacion previa del Superior Gobierno* (The Paleontological Society of Buenos Aires is formed by the free union of the founding members and under the prior approval of the Superior Government) (Burmeister, 1864–1869), done this on August 8, 1866, and making it clear that the Society was within the legal frameworks. The *Sociedad Paleontológica de Buenos Aires* had as its main purpose to study and to make the fossils of the "State" of Buenos Aires known, further promoting the *Museo Público de Buenos Aires* scientific progress. Meetings and sessions of the *La Sociedad Paleontológica de Buenos Aires*, from July 11, 1866, to March 11, 1868, were published together with the statute in volume 1 of the "*Anales del Museo Público de Buenos Aires*", between 1866 and 1868 (Burmeister, 1864–1869). The sessions recorded the progress of the museum, entry of new materials, acquisition of books and publications, deals with related societies, money movements, admission of new members, *etc*. Additionally, the scientific discussions were published, almost all with G. Burmeister as a principal lecturer on various issues, such as fossil cetaceans, fossil shell beds, glyptodonts, toxodonts, the origin of man, some living mammals, and insects. In other sessions, Professor Strobel exposed the importance of the current geographical distribution of terrestrial mollusks for geology and paleontology, and Gutiérrez spoke on the early discoveries of mammals in the Plata region. Even in its last year (1868), the association incorporated new members, such as General Brigadier Mitre, President; Dardo Rocha (1838–1921), future Governor of Buenos Aires; Avellaneda, Minister and future President; and the Italian professor Giovanni Ramorino (1840–1876), second geology professor at Universidad de Buenos Aires and fundamental in the early years of F. Ameghino.

The society continuously appealed to the provincial government of Buenos Aires for support and monetary contributions from the associates. Despite the efforts, the *Sociedad Paleontológica de Buenos Aires* had a short life, so the society sessions were no longer recorded by the second volume of the Annals. G. Burmeister informed that different

circumstances prevented the meetings of the *Sociedad Paleontológica de Buenos Aires*, so the progress of the museum would be informed through a published bulletin along with the *Anales del Museo Público de Buenos Aires* (Burmeister, 1870–1874).

Although it is difficult to assess the causes of the closure of the association (Auza, 1997), we must remember it was deliberating in the middle of critical circumstances, as internal revolts (for example, those led by the brothers Saá and F. Varela (1821–1870) against Mitre's government), one of the most terrible international wars in which Argentina has participated, the Paraguayan War (1865–1870), in which one of the society's member, Rocha, was seriously wounded), and a severe cholera epidemic that caused many victims, one of them Vicepresident Paz. Also, some members, like Strobel, who returned to Europe, left the society. Whichever the causes, the last entry of the Paleontological Society was on March 11, 1868, in the second volume of the *Anales* (1870–1874) as a new bulletin (Auza, 1997; Asua, 2012). Although short-lived, the *Sociedad Paleontológica de Buenos Aires* was a pioneer institution among the paleontological associations of Argentina and Latin America.

The Museum publications, the *Anales del Museo Público de Buenos Aires*

Since its arrival, G. Burmeister published different papers in foreign and national journals from 1864 to 1891, many on fossil mammals from the *Museo Público de Buenos Aires* collection. In foreign journals, for example, he preliminary described the magnificent skeleton of the saber-tooth *Smilodon* ("*Muñi-felis*") of Muñiz (Burmeister, 1868), then known as *Machaerodus*. Also, he wrote on glyptodonts in a local pharmacological journal, the "*Revista Farmacéutica de la Sociedad de Farmacia Nacional Argentina*", (1863–1864), reputedly the most ancient Argentine scientific publication since 1858 (see Babini, 1986). This article was also published in an English journal (Birabén, 1968). G. Burmeister also published about fossil ground sloths (Mylodontidae) in a popular periodical review, the "*Almanaque Agrícola, Industrial y Literario de la República Argentina y de Buenos Aires*" (1864–1865) (Mones, 2021), which dealt with different subjects, as agriculture or medicine new. So, it is clear that, for G. Burmeister, there was an urgent need for a proper scientific publication exclusive for the *Museo Público de Buenos Aires*. Finally, with official support and private contributions, G. Burmeister created the *Anales del Museo Público de Buenos Aires*, marking a milestone for scientific publications in Argentina, being the first one devoted to the natural sciences, zoology, and paleontology. The title of the first volume (1864–1869) was "*Anales del Museo Público de Buenos Aires, para dar a conocer los objetos de Historia Natural nuevos o pocos conocidos conservados en este establecimiento*" (Annals of the Public Museum of Buenos Aires to present the new or little-known natural history objects preserved in this establishment) (Burmeister, 1864–1869), with G. Burmeister as Director of the establishment. G. Burmeister, in the introduction or "*Proemio*" (October 20, 1864) mentioned that the government of Buenos Aires was a supporter and protector of the edition of the *Anales del Museo Público de Buenos Aires*, also stating that prominent members of the *Asociación Amigos de la Historia Natural del Plata* (Association Friends of the Natural History of Plata) promised to make every effort to ensure the publication and continuity of the volumes (but as we mentioned before, this did not happen). For G. Burmeister, the *Anales del Museo Público de Buenso Aires* were intended to position the museum alongside its international peers, being not only useful for the institution but also for the nation, recommending them to the youth of the country so that they could favor and protect this publication with their votes. Additionally, G. Burmeister thanked Gutiérrez, Rector of the University, for his assistance in publishing this work (Burmeister, 1864–1869). Ending the first volume of the *Anales del Museo Público de Buenos Aires,* the statute and sessions of the *Sociedad Paleontológica de Buenos Aires* were presented. The first volume consisted of a series of articles, all authored by G. Burmeister, written in Spanish (as were the other two following volumes). The first article outlined the history and collections of the museum, followed by one on contemporary paleontology, with interesting insights into biostratigraphy and the succession of life through the geological periods, being this the first work of its kind in Argentina. The rest of the volume included articles on living birds, cetaceans, and fossil mammals. The articles devoted

to the "*Pampean* fossil fauna" were of high quality, with descriptions that reflected G. Burmeister's anatomical knowledge. He described the main features observed in the skeletal remains and rightly suggested that some differences preserved in fossil species, considered of systematic value, might simply be individual variations. G. Burmeister began by describing the skull and partial skeleton of the *Macrauchenia* from the Bravard collection, acquired by the museum, using Bravard's original plates from his intended description of this ungulate, which he had planned to name *Opistorhinus* (due to the posterior position of the nares, a feature also noted and described by G. Burmeister). In the following article, G. Burmeister described the notoungulate genus *Toxodon* and its species with great detail and illustrated it with excellent drawings made by G. Burmeister himself, including the magnificent skull donated by Muñiz. Additionally, there is an article on the anatomy of glyptodonts as well as a general overview of fossil mammals known in Argentina, mainly from the Quaternary or Diluvial beds, along with others from the continental beds of the "*Tertiaire Patagonien*", accompanied by a solid geological synthesis. This first volume is a masterful work and, with its excellent plates, auspiciously inaugurated the scientific contributions to the Argentine paleomammalogy, published by the *Museo Público de Buenos Aires* in Argentina.

The second volume of the *Anales del Museo Público de Buenos Aires* (1870–1874) is an extraordinary, detailed monography (*"Monografía de los Glyptodontes en el Museo Público de Buenos Aires"*) devoted to the glyptodont family Glyptodontidae. In the preface, G. Burmeister explained the four-year delay in publishing the *Anales del Museo Público de Buenos Aires* attributing the delay to diverse causes such as the printing of the scientific plates, his advanced age, and his multiple tasks (*e.g.*, curator, sculptor, and designer). Despite these obstacles, the result is magnificent, with highly detailed descriptions absolutely of all the known genera of Glyptodontidae (*Panochthus*, *Hoplophorus*, *Glyptodon*, and *Doedicurus*), demonstrating his expertise as an anatomist. The detailed osteological descriptions of the skull and postcranial elements were also accompanied by cross-sections of the teeth, analyzing different dentine types, the hyoid apparatus (correcting previous errors published in the first volume), general features of the brain, presumed theoretical nerve projections from the optic area, muscular, and nervous insertions (Fig. 4.1), detailed descriptions of the carapace scutes and other dermal scutes from different parts of the animal, among other things. As in the first volume, but with more detail, the drawings and plates were mainly made by G. Burmeister (Fig. 4.2); these are magnificent and have been reproduced many times in other works. Some plates were made by the Swiss painter Adolf Methfessel (1835–1909) under G. Burmeister's direction. This work also included a photograph illustrating a caudal tube of *Panochthus*, a pioneering use of photography in Argentine science (Burmeister, 1870–1874; Toledo, 2022). The monograph of the glyptodonts exemplifies why the *Anales del Museo Público de Buenos Aires* deserve a special place in the history of Argentine mammalian paleontology. Even F. Ameghino, often critical of G. Burmeister, wrote that it was a monumental contribution to the Argentine paleontology (Ameghino, 1889). G. Burmeister also documented the origins of the specimens and often complained about the public damaging valuable pieces by taking pieces, especially scutes, as "*souvenirs*". He emphasized the great work required to reconstruct these animals, especially the carapace, and the effort made by the curator of the museum, Luis Fontana (1846–1920), who spent a year working on this task, something that was

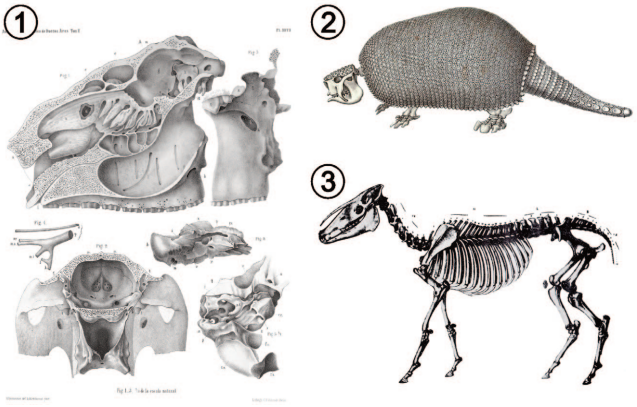

Figure 4. 1, *Glyptodon* skull showing internal structures and reconstructed nerve projection of the optic region (modified from plate 28, Burmeister, 1870–1874); **2, *Glyptodon clavipes*** skeleton and carapace (modified from plate 36, Burmeister, 1870–1874); **3, *Hippidion bonariense*** skeleton, taken from Burmeister (1875) but modified from Palcos (1943).

unappreciated by the visitors (Burmeister, 1870–1874). Ending the volume in a section called *Boletín del Museo Público de Buenos Aires*, G. Burmeister reported on the difficulties affecting the meetings of the *Sociedad Paleontologíca de Buenos Aires* and listed the novelties and acquisitions from 1868 to 1871, incorporated with the aid of the government, including the Bravard collection.

The third and last volume was published between 1883 and 1892 as *Anales del Museo Nacional de Buenos Aires* (Annals of the National Museum of Buenos Aires) (formerly Public Museum). The volume included the works of G. Burmeister on actual cnidaria, *Physalia* (Portuguese caravel) with a fine plate, and other studies on entomology, followed by the reproduction of the Monography of Bravard on the Tertiary terrains of Paraná and a series of articles on the fossil mammals of the Tertiary of Paraná by G. Burmeister himself. This volume had two other articles written by C. Burmeister, his son, detailing his trips to Monte Hermoso and Patagonia as a natural history traveler and collector for the *Museo Nacional de Buenos Aires*. The first fascicle was published as the *Anales del Museo Público de Buenos Aires.* The shift to a museo nacional *status* occurred in September 1884, as clearly stated at the end of the second fascicle. The last fascicle was published shortly before the death of G. Burmeister. In it, G. Burmeister commented on the species Bravard mentioned while also describing new mammals (*e.g.*, rodents, litopterns, and toxodonts) and reptiles. Some of these materials were based on specimens of the *Museo Nacional*, others collected by Enrique de Carles (1861–1934), who was by then working as a collector for G. Burmeister's museum, and additional specimens shown to G. Burmeister by Professor Scalabrini in Paraná. G. Burmeister also described forms from Patagonia, collected by Lista and his son (like *Colpodon* from Chubut), and provided detailed descriptions of Patagonian Tertiary mammals of the *Museo de La Plata* (as the toxodontid *Adinotherium*). This last volume showed the changing times, where the generation of the old German sage director is being replaced by the young generation in the Argentine paleontology. In 1892, it was evident that the *Museo de La Plata*, directed by Moreno, was competing with the museum directed by G. Burmeister, benefiting from greater resources. At La Plata, G. Burmeister had access to the fossil mammals collected in the Miocene of Santa Cruz Province, as stated by G. Burmeister, whose attitude with Moreno went from cordial to critical. In one article in the *Anales del Museo Público de Buenos Aires*, he critiqued some new species published in the "*Revista del Museo de La Plata*" by Moreno and the Swiss naturalist Mercerat (Ameghino's successor after he resigned from the *Museo de La Plata*). G. Burmeister remarked that Moreno's significant resources could have been better used. When examining an article by Mercerat on Miocene Santacrucian toxodontids, G. Burmeister stated that a bad example corrupts good customs, suggesting that Mercerat followed F. Ameghino as a poor example.

Finally, the old dispute with F. Ameghino returned with all its intensity in some articles of this last volume, with G. Burmeister criticizing many of the works of F. Ameghino, sometimes justifying this idea by pointing out that many of the anatomical references used by F. Ameghino were wrong. Furthermore, G. Burmeister evaluated several of the publications by F. Ameghino such as the "*Contribución al conocimiento de los mamíferos fósiles de la Argentina*" (Ameghino, 1889), published by the *Academia Nacional de Ciencias* in Córdoba Province, an institution that had embittered G. Burmeister in the past. G. Burmeister criticized the text and especially the figures that he found particularly substandard. Then, he examined the new journal published by F. Ameghino, the "*Revista Argentina de Historia Natural*" (1891), in which F. Ameghino critiqued G. Burmeister's work and introduced many new species. However, the critics of G.Burmeister against the new taxa proposed by F. Ameghino were sometimes unjustified; this time, G. Burmeister disqualified F. Ameghino's work with a tremendous and harsh phrase: "*cometiendo nuevos errores y haciendo nuevas especies, creciendo los dos en el suelo pútrido de sus obras,como los hongos en la basura, que es el verdadero terreno del nacimiento de éstos*" (making new mistakes and creating new species, both growing in the putrid soil of their works, like mushrooms in the garbage, which is the true terrain of their birth) (Burmeister, 1883–1891, p. 471). Finally, the almost sure origin of the feud of their conflict appeared on the scene: the fossil human (Toledo, 2022). G. Burmeister remained skeptical of the human fossil findings, such as the one by the Spanish collector de Carles at the San

Borombon River (Buenos Aires Province), which was widely known then. G. Burmeister was similarly dubious about the fossil human from the Frías rivulet found by F. Ameghino because he considered all the fossil human findings claimed by F. Ameghino as exagerated as the supposed 12 fossil human skeletons at Córdoba Province (Ameghino,1885). Among his many complaints, G. Burmeister commented that he came to this country to apply his scientific skills for its benefit and could not ignore how "my science", the paleontology, was, in his opinion, so poorly treated by F. Ameghino. By the ending of this *Anales del Museo Público de Buenos Aires,* G. Burmeister dedicated one of his last scientific writings to a final, caustic remark about F. Ameghino: "*Como un aviso al público, agrego que no contestaré jamás á quejas y nuevas invectivas del señor Ameghino, tratándole como individuo que no existe, dejando en olvido sus obras y su persona*" (As a warning to the public, I add that I will never respond to complaints and new invectives from Mr. Ameghino, treating him as an individual who does not exist, leaving his works and his person in oblivion), finishing in latin "*Dixi et salvavi animam meam*" (I said, and I have saved my soul) (Burmeister, 1883–1891, p. 487). This phrase was the final stroke on this long and famous quarrel between these two extraordinary figures of the Argentine mammalian paleontology.

De Carles, who found the Sanborombon human skeleton and worked some time as a traveling naturalist for the *Museo Nacional de Buenos Aires*, eventually left this post to become an independent collector, selling his magnificent collection of fossil mammals from the Quaternary and Pliocene of Argentina to the rich Spanish businessman, José Rodrigo Botet (1842–1915). Botet subsequently donated it to the Museum of Valencia (Spain), where the San Borombon skeleton is housed, among many other mammalian fossils (Simpson, 1984; Casinos, 2012).

Two important works by G. Burmeister were published between the second (1870–1874) and third volumes (1883–1891) of the *Anales del Museo Público de Buenos Aires.* The first, "*Caballos Fósiles de la Pampa Argentina*" (Fossil Horses from the Argentine Pampa) (Burmeister, 1875), was sponsored by Buenos Aires for the Universal Exposition of Philadelphia in 1876. This work was presented with a "Supplement" (1889) in Paris. This was a splendid contribution devoted to fossil horses of Argentina and illustrated with beautiful plates describing some magnificent specimens, such as the complete *Hippidion* skeleton bought by the museum (Fig. 4.3), and included an outstanding mastodont skull made by Methfessel in such supplement. This contribution received several important distinctions (Mantegari, 2003). The second work, released in 1881, was an ambitious project entitled "*Description physique de la Republique Argentine*" (1876–1879) (Physical description of the República Argentina), which was published in several volumes, with the final one being an *Atlas* with masterful plates. This book was written in French, probably to reach a broader audience. This contribution proposed a comprehensive knowledge of Argentina's territory, geology, and fauna. One volume was focused on vertebrates, describing the Argentine mammals, their nature, origin, and development. G. Burmeister described living mammals and many extinct forms, such as *Toxodon*, *Nesodon*, *Typotherium*, *Macrauchenia*, mylodontids, megatheriums, and glyptodonts. He also described new species like the "*Anchitherium australe*", a proterotheriid litoptern, brought by Lista from Patagonia, and also the skull of *Astrapotherium patagonicum*, which he named without the authorization of Moreno, who had brought it from Patagonia, provoking new frictions between Moreno and the old professor. The second volume, among other things, reviewed what was then known of the geology of Argentina, based on D'Orbigny, Darwin, Bravard, and G. Burmeister's observations. The geological succession known by then was very simple for Tertiary and Quaternary deposits. G. Burmeister distinguished first the "*Formation tertiaire inférieure dite guaranienne*" (lower tertiary Formation named Guaranian), then the "*Formation tertiaire supérieure dite patagonienne*" (upper tertiary Formation named Patagonian), with marine fossils, especially invertebrates, and some terrestrial vertebrates. For G. Burmeister, the deposits of Paraná were deposited near the coast. The terrestrial mammals then recorded for the "*Patagonienne*" ("Patagonian") were a mixed assemblage of taxa as those from Paraná like the "*Anoplotherium americanum*" (currently a litoptern), and others coming from Patagonia as the toxodontid *Nesodon imbricatus*, supposedly coeval, but nowadays acknowledged to pertaining to different ages. Then comes the "*Formation diluvienne, dite quaternaire ou*

postpliocene" (Diluvian Formation for the Quaternary or post-Pliocene), in other words the "*Pampean*" formation. In a very detailed synthesis, G. Burmeister described the fossil deposits and the mode of their deposition and concluded that these fossiliferous beds were the result of a long temporal series of alluvial deposits made by rivers and streams, occasionally accompanied by sand deposits that could also cover the remains of extinct mammals. He rejected Bravard's idea that the Pampean deposits were dunes that originated from the action of the wind. However, G. Burmeister accepted the taphonomic observations made by Bravard concerning the presence of marks attributable to insect larvae, similar to those seen in actual remains lying on the surface and exposed to the elements rather than submerged, as Darwin suggested. Above the *Pampean* beds were the more recent "*Formation moderne des alluvions*" (Modern Formation of alluvium). The "*Description physique de la Republique Argentine*" represents a magnificent influential contribution in the fields of geology and paleontology and was supported by the national government in order to be presented at the Universal Expositions of Paris in 1878 and 1889 (Asúa, 1989).

G. Burmeister and the Argentine paleontology

G. Burmeister's figure has sometimes been overshadowed or diminished, mainly by his conflict with F. Ameghino and alleged adherence to "creationism", the latter claim false. For example, the great paleontologist George Gaylord Simpson (1902–1984), who knew well our mammalian paleontology, in his book on the history of paleontology in South America, briefly mentions G. Burmeister by his quarrel with Ameghino, describing him as a "Teuton of the old school… a rigid biblical creationist" opposed to the Darwinism of F. Ameghino (Simpson, 1984, p. 77). For Simpson, G. Burmeister's primary contribution was associated with Muñiz's materials and the assemblage of the collections of the Pampean fossil mammals for the *Museo Nacional de Buenos Aires* (Simpson, 1984). However, G. Burmeister's contributions were more than these, not only in reference to his work within the collections but also to the protection of the provincial fossils. He created the *Anales del Museo Público de Buenos Aires,* which was the first proper natural science publication in Argentina (Babini, 1986), and he produced a wealth of scientific studies and provided masterful anatomical descriptions *(e.g.*, neurological or nervous innervations), displaying a level of expertise unmatched by other Argentine paleontologists of the late XIX Century. His efforts contributed significantly to the international renown of the *Museo Nacional de Buenos Aires* even within his lifetime, positioning him as a foundational figure in Argentine paleontology and helping to establish it as a respected scientific field beyond national borders.

Geology and the "*Conquista del Desierto*" (Conquest of the Desert)

The brothers Oscar (1844–1917) and Adolf Doering (1848–1925) or Döring, from the *Academia de Ciencias de Córdoba*, despite quarreling with G. Burmeister in the "Córdoba episode", remained affiliated with the academy. Later, they became friends with F. Ameghino, sharing their rivalry with G. Burmeister (see Márquez Miranda, 1951; Podgorny, 2011d). Adolf Doering participated as a naturalist in the Río Negro military expedition (1879), commanded by the young general Julio Argentino Roca (1834–1914), during the presidency of Avellaneda. This expedition, popularly known as the "*Conquista del Desierto*", began the national government's definite occupation of the Argentine territory. The expedition produced several scientific reports, such as the geological study by A. Doering (1880) that covered the surveyed areas. In his extensive introductory discussion of the Cenozoic, A. Doering expressed that the Argentine formations and their correlations, based on a comparative paleontological study, were incomplete compared with those of the United States of America and Europe. Doering discussed past movements of land and sea, the extension of the sea, and the criteria concerning the recognition of the stages of Cenozoic periods in Europe, among other things. In discussing marine fossils and their implications for past sedimentation and coastal distance, A. Doering recognized G. Burmeister's accurate observation that the fossils from the Paraná marine "Patagonian" indicated estuarine and near-coastal deposits. Then, he discussed the recognized Cenozoic Argentine formations, detailing the main fossils known for each formation and stage, expanding G. Burmeister's geological framework and introducing a new classification for the Cenozoic (Fig. 5), his Neotropical

Cenozoic Formations System for the Austral-Atlantic region. This included: (I) the "Eogene" formations (with almost all extinct genera), with the Guaranitic Formation (Eocene or Upper Cretaceous), and the Guaranitic and Pehuenche stages (the latter with the unusual fossil mammal "*Mesotherium*"); and the Patagonic Formation (Oligocene) with the Mesopotamian (terrestrial mammals) and the Patagonian (marine with *Ostrea patagonica*) stages, and (II) the Neogene formations, with the Araucanian Formation (Miocene), including the Araucanian (with *Nesodon* and "*Anchitherium*") and the Puelche stages. Above these, the Pampean Formation (Pliocene and "Pre-Glacial"), with the Lower Pampean, Eolitic, and Lacustrine Pampean stages, later known as Ensenadan, Bonaerian, and Lujanian (Tonni, 2011). The overlying Tehuelche Formation (Glacial) and the Querandina Formation or Post-pampean (Diluvial) (Querandine and Platan stages, with estuarine and freshwater mollusks). Finally, the Arian Formation (alluvial) has recent mammals, including the European one brought by the Spaniards. Although incomplete by modern standards, A. Doering's scheme was remarkably comprehensive, given the limited understanding of Argentine Cenozoic stratigraphy (Doering, 1882; Salgado *et al.*, 2007; Tonni, 2011).

A NEW GENERATION OF ARGENTINE PALEONTOLOGISTS: MORENO AND F. AMEGHINO

Moreno, a museum from Buenos Aires to La Plata

Moreno, known as the "*Perito Moreno*", was born on May 31, 1852, in Buenos Aires city. His father, Francisco Facundo Moreno Visillac (1819–1888) was a prosperous merchant well-known in the "illustrated" society, with many political relationships that undoubtedly helped his son. However, Moreno's achievements were attained by his strong personality, skills, and unwavering purpose rather than merely family wealth. From an early age, Moreno became interested in exploration voyages and natural history collections (Moreno, 1879). Although he lived in the city, his father bought a property, a "*quinta*" called the "*Edén de San Cristóbal*", in the southern part of the city, which was by then a rural area, and currently located within the Parque Patricios neighborhood. In their home, Moreno and his brothers created his first "museum", displaying various objects, including fossils given by the Rector Gutierrez, an old friend of his father, and a dasypodid fossil. Having visited G. Burmeister at the *Museo Público de Buenos Aires*, the Director occasionally visited Moreno's "museum", where he examined the dasypodid, mentioning a few years later that this specimen at Moreno's "*Museo Arqueológico*" (archaeological museum) could belong to a new species (Burmeister, 1879). Between 1867 and 1868, a cholera epidemic struck, claiming many lives, including Moreno's mother and the Argentine vice president, Paz. Then, in 1871, the "*fiebre amarilla*" (Yellow Fever) epidemic devastated the city of Buenos Aires, so Francisco's father sent his family to his brother-in-law's ranch near the Vitel and Chascomús lagoons in southern Buenos Aires Province. While there, young Moreno made significant archaeological and paleontological collections. At his return to Buenos Aires, Moreno brought his new collections to the "*Edén*", which grew increasingly and soon needed dedicated display space. For his 20th birthday, as a gift, his father constructed a building on the farm for his collection,

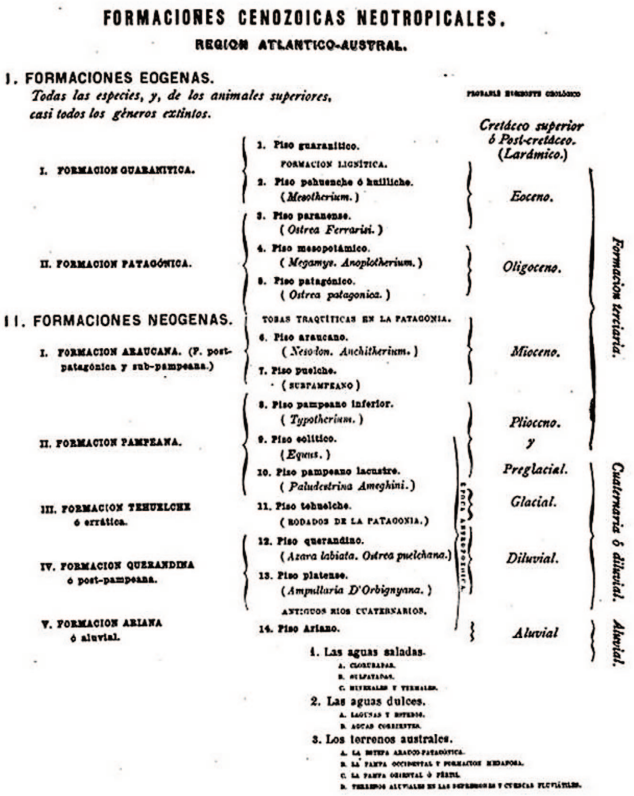

Figure. 5. Stratigraphic scale of Doering (1882) (modified from the original).

including a laboratory and a library (Fasano, 2002; Farro, 2009), designed by the German engineer Otto von Arning (or Arnim, 1824–1889) (De Barrio, 1923; Farro, 2009), a former member of the *Sociedad Paleontológica de Buenos Aires*. This first "museum", inaugurated in November or December 1872, had a neoclassical front (Fig. 6.1) reminiscent of the future *Museo de La Plata* (De Barrio, 1923; Fasano, 2002). There, Moreno received visitors like Manuel Eguía (1808–1880), a founding member of the *Sociedad Paleontológica de Buenos Aires* and fossil collector, who gave Moreno several ideas and advice on the preservation and arrangement of the collection. Even G. Burmeister designed part of the exhibition shelving (De Barrio, 1923).

In 1872, several students of the Department of Exact Sciences of Buenos Aires, among them Estanislao S. Zeballos (1854–1923), decided to create a scientific association, the *Sociedad Científica Argentina* (Argentine Scientific Society), on July 14, at the *Colegio Nacional* (National College). As a prominent exponent of scientific advancement, the Society became closely associated with Moreno, supporting him financially and publishing his works and conferences. Formerly interested in anthropology, mainly indigenous skulls (it was the Age of the Craniology), Moreno decided to visit Patagonia after receiving many materials from Carmen de Patagones (Farro, 2009; Moreno, 2009). So, in 1873, Moreno embarked on his first trip to Patagonia, visiting Carmen de Patagones, the Río Negro, and nearby places, collecting archaeological materials (Ygobone, 1979; Fasano, 2002). He corresponded with the French anthropologist Pierre Paul Broca (1824–1880), and Moreno published his research on Patagonian archaeology in 1874.

After a bounding quarrel with Chile, in 1874, Argentine President Sarmiento sent a naval expedition to Santa Cruz Province. Moreno was accepted as a member and, by agreement between Moreno and G. Burmeister, the zoologist Carlos (Karl) Berg (1843–1902) of the *Museo Público de Buenos Aires* also joined the expedition. They departed on the schooner brig "Rosales" in August 1874, returning in December (with Avellaneda as new President). In the Tertiary layers of Santa Cruz, they collected fossil mollusks, especially *Ostrea*, and remains of fossil cetaceans, one of them later named by Moreno as "*Palaeobalaena bergii*" in homage to his companion and friend, Berg (Moreno, 1882). Above the marine deposits, on the "Tertiary yellow sands", they extracted remains of a "large *Glyptodon*" (Moreno, 1882). This area had been visited by Darwin, who referred to the terrain (marine and terrestrial) as the "Patagonian Tertiary". Currently, the marine sediments on the Santa Cruz Bay represent the Monte León Formation (late Oligocene–Early Miocene; 27 to 20 million years) (Cuitiño *et al.*, 2016) and the overlying terrestrial layers with mammals to the Santa Cruz Formation (late Early–early Middle Miocene; 17 to 16 million years old) (Cuitiño *et al.*, 2016). After his return from Patagonia, Moreno went to Paraná to examine the Tertiary marine formations, compare them with those of Patagonia, and collect fossils (Moreno, 2009). His appointment as an academic of the

Facultad de Ciencias Físicas y Naturales de Buenos Aires (Faculty of Physical and Natural Sciences of Buenos Aires, 1875), and as an assistant to Dr. Berg's Zoology chair, brought criticism from his cousin, Eduardo Ladislao Holmberg (1852–1937), a notable Argentine naturalist and writer. Holmberg satirized Moreno as "Francisco Paleolitez" (Burmeister new sage "*protégé*", Farro, 2009), in his novel "Two Parties in Struggle" (1875), regarding the dispute between "Darwinists" and "anti-Darwinists" scientists at a conference in Buenos Aires, where Darwin participated as a guest. Despite this, Moreno continued his work and projects, being an active member of the "*Sociedad Científica Argentina*". In September 1875, Moreno returned to Patagonia, visiting Darwin's site at Punta Alta in Bahía Blanca. He collected fossil seashells and bones of fossil mammals (Moreno, 2009). He continued his journey and finally reached the Lago Nahuel Huapi, but he was not authorized by Chief Shaihueque (1818–1903) to cross to Chile. Due to this, Moreno returned to Patagonia in March 1876 (Moreno, 1879). Following further explorations in Catamarca Province, Moreno prepared another trip to Patagonia, to the Río Santa Cruz, to reach its headwaters. The government was interested, and President Avellaneda approved this project. So, on October 20, 1876, Moreno departed from Buenos Aires in the schooner "Santa Cruz", a famous Argentine sailor commanded by Luis Piedra Buena (1833–1883). Along the route, they collected many marine

fossils in Chubut Province, in what was by then known as the "Patagonian Tertiary" formation, as recognized by d'Orbigny, exposed in Paraná and along the Patagonian coast. For Moreno, these beds provided evidence of a major marine incursion in the southern part of the continent (Moreno, 1879), with the fossils found there of the same species already recorded in Paraná, indicating a similar age between the Patagonian beds and those from Paraná. Today, it is known that the old "Patagonian Tertiary" includes different formations ranging from the Upper Oligocene to the Upper Miocene (between 27 and 9 million years old), reflecting different Atlantic incursions into the continental territory.

In January 1877, the group of Moreno, accompanied by the Navy Second Lieutenant Carlos M. Moyano (1854–1910) as a cartographer, began the hard ascent of the Río Santa Cruz, towing the boat against the current to reach its headwaters, which were poorly known. In 1834, Fitz Roy (1805–1865) had come close to the objective, whereas G.H. Gardiner in 1867 and Navy Second Lieutenant V. Feilberg (1852–1913) of the Argentine navy in 1873 had reached one of the lakes feeding the river. Moreno and his companions reached the headwaters of the Santa Cruz River on February 14, 1877, naming the lake Lago Argentino and discovering the Viedma and San Martín lakes. On February 4, 1877, while ascending the river, in a series of "yellowish rocks" outcrops not far from the river, Moreno discovered a fossiliferous site with "the tusk of a powerful missing pachyderm", likely from the Eocene period and "not yet reported in Patagonia" (Moreno, 1879, p. 303). In other layers, probably younger, he found more fossils of mammals (*e.g.*, marsupials and edentates) (Moreno, 1879). He also observed layers with *Ostrea patagonica*, which indicated "the immense fossiliferous mantle that extended from Paraná to Tierra del Fuego, on the Atlantic coast", penetrating "the heart of Patagonia" (Moreno, 1879, p. 312).

In the Tertiary layers of the Río Shehuen, he found petrified trees and oysters, and near San Martín Lake, samples of "stone coal" similar to the lignite of Punta Arenas. For Moreno, this suggested an "opulent vegetation" covering "the west of eastern Patagonia" from the early Cenozoic or late Mesozoic (Moreno, 1879, p. 407–408). This discovery was also the first for Santa Cruz Province.

Back at the site where he first found the fossil mammals, Moreno extracted a large part of the "great pachyderm" skull (Fig. 6.2). In other supposedly younger beds, he collected additional mammals (*e.g.*, glyptodonts, dasipodids, and a toxodontid notungulate, *Nesodon*) (Moreno, 1879). Today, all the levels from where Moreno collected the mammals belong to the Santa Cruz Formation.

Moreno (Fig. 6.4) arrived in Buenos Aires on May 8, 1877, and began writing his voyage narrative. Also, an important event occurred for Moreno and his "museum" that same year. Except for a partial exhibition of Moreno's collection in a rented space at the commercial house of Fusoni Hermanos (Masán, 2023) in Buenos Aires city, the general public had not accessed it. In conversations with Vicente G. Quesada (1830–1913), Minister of Government

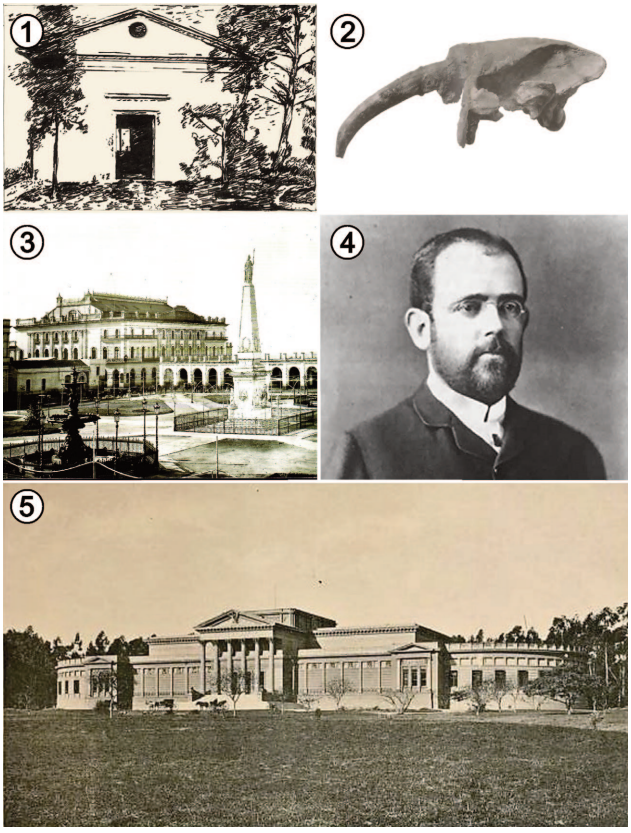

Figure 6. 1, Front of the F. P. Moreno Museum, *ca.* 1872, *quinta El Edén de San Cristóbal*, Parque Patricios, Buenos Aires city (modified from Bond, 2022); **2,** ***Astrapotherium patagonicum*** ("***Mesembriotherium broccae***") skull (type **MLP-PV** 12-94) modified from plate 21, Lydekker (1894c); **3,** Antiguo Teatro Colón, right across the Plaza de Mayo, at Buenos Aires city (modified from Bond, 2022); **4,** F. P. Moreno, in 1882 (modified from Moreno Terrero de Benites, 1988); **5,** Museo de La Plata, *ca.* 1890–1891 (modified from plate 1, Moreno, 1890–1891).

of Buenos Aires Province (under Governor Carlos Casares, 1830–1883), Moreno offered his collections as the basis for the *Museo Antropológico y Arqueológico de Buenos Aires* (Anthropological and Archaeological Museum of Buenos Aires), with the condition of him being appointed as its Director "in perpetuity" and that the collections should not be moved to another establishment. After a debate in the Buenos Aires Chamber of Deputies, and besides some objections, a group of deputies highlighted the importance of Moreno's collection, pointing out that it would be a shame if taken abroad, the project was approved and subsequently passed in the Senate. A Protective Society was organized for the new museum, covering the costs of moving the collections from the "*Edén de San Cristóbal*", renting a suitable place, exhibition shelves, and the doorkeeper's salary. Prominent figures, including Mitre and Sarmiento, contributed with money and donations of archaeological materials and fossils, such as a *Toxodon platensis* by Colonel Alvaro Barros (1827–1892), a prominent frontier chief (Bond, 2022). The law establishing the Museum was promulged on October 17, 1877, with Moreno as its Director (De Santis, 1977; Moreno Terrero de Benites, 1988). On August 1, 1878, *the Museo Antropológico y Arqueológico de Buenos Aires* opened to the public on the fourth floor of the old Teatro Colón (today, the Banco de la Nación Argentina - National Bank of Argentina) (Fig. 6.3), in front of the Plaza de Mayo, where with Moreno delivered a conference on "The study of South American Man".

In March 1879, President Avellaneda appointed Moreno to lead an expedition to Patagonia, which Moreno accepted, requesting the right to incorporate into his museum the materials collected (Ygobone, 1979; Fasano, 2002). That same year, his book "*Viaje a la Patagonia Austral, emprendido bajo los auspicios del gobierno nacional 1876–1877*" (Voyage to Southern Patagonia undertaken under the auspices of the national government 1876–1877) (Moreno, 1879) was published twice by the *Oficina de impresión de La Nación* (Nation Printing Office, Mitre's newspaper). The book aroused official interest, highlighting the southern region's great value, and the Executive branch acquired 500 copies for distribution (Fasano, 2002).

In October 1879, Moreno set out to Patagonia. The expedition faced difficulties from the beginning due to Moreno's disagreements with the ship provided and proposed route modifications, which the new Minister of the Interior, Benjamín Zorrilla (1840–1896), in replacement of Sarmiento, denied. While surveying the ship in Viedma, Moreno, and his companions disobeyed the instructions and went westward on a horse. That year, the traditional defensive strategy against the indigenous tribes had been replaced by an offensive one, relocating the southern border to the Río Negro as proposed by General Roca, Minister of War of President Avellaneda, in what became the "*Conquista del Desierto*". Unsurprisingly, this worried the indigenous groups, who became wary of intruders. So, when Moreno and his companions arrived at Nahuel Huapi, they were imprisoned by Chief Shaihueque. However, Moreno managed to escape, along with his companions, on a raft by the Collón Curá River, reaching an army fort on February 19, 1880.

Despite public acclamation upon the arrival of Moreno to Buenos Aires on March 11, 1880 (Fasano, 2002), Minister Zorrilla and other government members were dissatisfied with Moreno's behavior and called for his resignation. Although congratulated by President Avellaneda, in order to put an end to this problematic situation, Moreno resigned from the commission and, with the permission of Governor Carlos Tejedor (1817–1903), stepped down as the Director of the museum, Moreno traveled to Europe, arriving in Paris to attend university courses, particularly in Anthropology under Professor Broca. In May 1881, he was named a member of the French Geographic Society, receiving the Gold Medal highlighted in Buenos Aires newspapers such as the "La Nación". Moreno also visited London and its museums (Ygobone, 1979), making exchange agreements with European institutions (Barba, 1977). In June 1881, Moreno returned to Buenos Aires, finding a city profoundly changed by political events that occurred while Moreno was in France. Following Moreno's success in the 1879 expedition, General Roca became an optimate candidate to succeed President Avellaneda, with the approval of nearly all the provinces, Roca supported the project of making Buenos Aires the national capital. Against this project was Tejedor, Governor of Buenos Aires, who wanted to maintain the "*status quo*" of coexistence between national and provincial authorities in Buenos Aires, avoiding

its designation as the capital and the nationalization of revenue from the city's port. In April 1880, electors in nearly all provinces supported Roca, with only Buenos Aires and Corrientes supporting Tejedor. The confrontation became inevitable, and after intense fighting and numerous casualties, Buenos Aires and Corrientes were defeated, and Tejedor resigned as governor. In October 1880, Roca was proclaimed president and Buenos Aires was declared the republic's capital. As a result, Buenos Aires required a new capital. While this was under deliberation, Moreno and F. Ameghino, knowing each other, made a plan for a future museo nacional. Moreno expected that his political influences would be determinant in this project. In a letter to his brother Juan in October 1881, Florentino wrote that, with Moreno as Director, he would be in charge of the Paleontological Section of the new *Museo Nacional* and that J. Ameghino, his brother, would be hired as a preparator, confident that the congress would accept this project. He added sarcastically that the G. Burmeister's museo público would be abolished or relocated to the countryside. However, in July 1882, F. Ameghino informed J. Ameghino that the project had failed since the new Minister in charge, Eduardo Wilde (1844–1913), opposed it (Márquez Miranda, 1951). Consequently, G. Burmeister´s museo público was going to become a *Museo Nacional* and Moreno's museum would go to the countryside (the future La Plata city) (Torcelli, 1913–1935; Marquez Miranda, 1951; Podgorny, 2021).

Moreno's *Museo Antropológico y Arqueológico de Buenos Aires* continued in the old Teatro Colón while the location of the new provincial capital was pending. Despite future uncertainties and the lack of support from the new provincial authorities, Moreno's efforts secured donations from abroad (such as from the Paris Museum and British Museum) and locally (from the former museum of the Sociedad Científica Argentina). Then, Dr. Rocha, a former G. Burmeister's Paleontological Society member, became the Governor of Buenos Aires and initiated the construction of the new provincial capital, La Plata, officially founded on November 19, 1882.

During this period, Darwin died (April 1882) and the Argentine Darwinists prepared their homages. So, on May 19, 1882, the Medical Circle organized a "Carlos Roberto Darwin" conference at the Teatro Nacional (National Theater), attended by a large audience. Speakers included Sarmiento and Holmberg, Moreno's former antagonist with whom he had reconciled. Both conferences were interesting and provocative, with Holmberg criticizing G. Burmeister's work, and Sarmiento highlighting F. Ameghino as one of the few followers of Darwin in Argentina, also noting his work showing that humans in these lands were contemporary with the extinct fauna and were much older than previously assumed (Sarmiento, 2009; Holmberg, 1882). Additionally, after the invitation of the Argentine Geographical Institute to the "*Exposición Continental de Buenos Aires*" (Continental exhibition of Buenos Aires,1882), Ameghino gave a two-part conference on the "*La Edad de Piedra*" (The Stone Age), the second one being an homage to Darwin, advocating transformism as an exact science (Ameghino, 1882).

Following Darwin's homages, on July 15, 1882, sponsored by the Sociedad Científica Argentina, Moreno gave a conference entitled "*Patagonia. Resto de un antiguo continente hoy sumergido*" (Patagonia. Remains of an ancient continent today submerged), as a contribution to the collections of the *Museo Antropológico y Arqueológico de Buenos Aires*. The latter was done to highlight the significance of the materials exhibited and their importance in Patagonia's past natural history, noting that natural sciences were gaining prominence in the country. After discussing general points, Moreno proposed that available evidence suggested the southern region as a remnant of a vast, ancient continent, with Patagonia representing an early center of dispersion (Moreno, 1882; Windhausen, 1931; Riccardi, 2019). This dispersal pattern seen in living groups, such as the marsupials, supported the idea of a large southern continent that facilitated the dispersal of certain groups. He noted that Australia was among the first continental masses to separate from the southern continent, isolating those primitive groups, such as the marsupials. Moreno posited that in the Mesozoic and early Cenozoic, the Southern Hemisphere had more continental areas than the boreal ones, and part of South America, with the Brazilian massif, headed towards Southern Africa with other part communicating with Australia, as Antarctica would have splendid forests on its coasts. Moreno pointed out that except for a few mammals found in the Tertiary of

Patagonia, such as *Nesodon*, little was known about the Patagonian mammalian fauna, assumed precursor of the Quaternary Pampean fauna. Then, Moreno listed his findings concerning the fossil mammals in Santa Cruz (see Moreno, 1882; Bond, 2022), first the gigantic mammal skull and tusk, named by G. Burmeister (1879), *Astrapotherium patagonicum* (currently *A. magnum*). Upset by its unauthorized description (see Fernicola, 2011b), Moreno renamed it "*Mesembriotherium broca*" in honor of Professor Broca. However, he found its affinities uncertain as he recalled it as a pachyderm, a carnivore, or even a marsupial. Today, it is the first known cranium of an Astrapotheria (*Museo de La Plata*, MLP-PV 12-94), an extinct order of South American native ungulates (Lydekker, 1894c). In the same levels, Moreno collected a small marsupial named "*Palaeothentes aratae*" after his friend, Professor Pedro Arata (1849–1922), which corresponded to the Caenolestidae family. Moreno also discussed toxodontid remains, such as a *Nesodon*, which he and Lista found in Santa Cruz. In his Santa Cruz collecting site, Moreno also recovered small mammals, which he described as transitional between rodents and toxodonts, naming them "*Toxodontophanus australis*", *Interatherium rodens,* and "*Tembotherium holmbergi*", the latter in honor of his cousin "friend and colleague" Holmberg. These three species are currently recognized as *Protypotherium australe* for the first species nominated by Moreno and *Interatherium rodens* for the other two (Fernández & Muñoz, 2019; Fernández *et al.*, 2019). These were later studied by F. Ameghino, who represented the first recognized Interatheriidae remains, a group of small rodentiforms, Notoungulata.

Regarding the "Edentates" or xenarthrans, characteristic of South American Quaternary faunas, Moreno considered that although they had also been recorded in North America for Pliocene times, the accurate center of appearance would be the southern region. Among his findings in Santa Cruz was the glyptodont "*Hoplophorus australis*" (now *Paleohoplophorus australis*). All these fossil mammals indicated to Moreno that Patagonia was once a terrestrial center of development prior to the emergence or formation of the Pampas and that the last changes occurred as migrations through the Isthmus of Panama (probably also one of the first to recognize the Great American Biotic Interchange). He attributed the extinction of the Patagonian faunas to geological changes, volcanic eruptions, and glaciations. In conclusion, Moreno wrote that Patagonia, including Tierra del Fuego, were remnants of a Southern Continent, where the animals that still inhabit parts of South America, New Zealand, Tasmania, Australia, and Africa first appeared and evolved. He saw that the Southern Hemisphere was a zoogenic nucleus like the Old World and North America. For Moreno, the principal task of the *Sociedad Científica Argentina* was "*el conocimiento físico y moral de nuestro país, desde los tiempos geológicos más remotos, hasta nuestros días, y su relación con las demás regiones de la Tierra*" (the physical and moral knowledge of our country, from the oldest geological times, to the present day, and its relationship with the other regions of the Earth) (Moreno, 1882, p.131).

The remains found by Moreno in the Río Santa Cruz River from the Santa Cruz Formation (Miocene, 17–15 million years) made him the first national collector of these fossil-rich sediments, later exploited by C. Ameghino and numerous national and foreign collectors.

In 1884, the Museum of Buenos Aires was nationalized, and G. Burmeister became the Director of this new (at least in name) National Museum. In that same year, the provincial authorities of Buenos Aires moved to the new capital, La Plata. The collections of the *Museo Antropológico y Arqueológico de Buenos Aires* became the basis for a new provincial museum and were temporarily relocated to La Plata (Barba, 1977; De Santis, 1977). That year, Moreno was appointed Director of the *Museo de La Plata*, officially founded by provincial decree on September 17, 1884. The museum's construction began in October, with a partial official opening on July 20, 1885, and the new institution officially named *Museo de La Plata* (Fig. 6.5) (Moreno, 1890–1891) was inaugurated in 1887, with the presence of Sarmiento. Synthetically, regarding the mammalian paleontology in La Plata, Florentino Ameghino, invited by Moreno, left his post as a professor in Córdoba and was appointed as Vice-Director and Secretary in July 1886, with his brother Carlos as traveling naturalist. Carlos began his famous trips to Patagonia (two for the *Museo de La Plata*) and Monte Hermoso, collecting numerous fossil specimens in Santa Cruz. Although Moreno and Ameghino had a former

project of a museum in common, their partnership ended, and in February 1888, Florentino resigned due to his discrepancies with Moreno, beginning a long-standing feud with him. Carlos accompanied his brother and left his post during his second trip (Fernicola, 2011a, 2011b). Nonetheless, following Carlos' leaving, the remaining staff (Antonio Seinfeld and Eduardo Botello) continued collecting, this time in Chubut, obtaining fossil mammals and some notable dinosaur bones (von Huene, 1929). Subsequent expeditions provided more fossil specimens of mammals and birds.

In 1884, the taxidermist and preparator Antonio Pozzi was incorporated into the museum briefly (Laza, 2019). During this time, Moreno began a museum's journal, the "*Revista del Museo de La Plata*", published between 1890–1891 and featuring many works on paleontology by Moreno, Mercerat, and the forthcoming researchers incorporated into the paleontological section. After F. Ameghino's departure, the Swiss geologist Mercerat (Fig. 7.1) led the Paleontological Section in 1889 and became the Vice Director and Secretary of the *Museo de La Plata* (Ramos, 2023) in 1891. Mercerat conducted an expedition to Patagonia in 1892 but resigned his position in 1893, due to personal differences with Moreno, subsequently working as a land surveyor. Mercerat published different articles from 1891 to 1925, mainly in the *Revista del Museo de La Plata* and the *Anales del Museo Nacional de Buenos Aires*, covering fossil mammals, birds, and geological notes on Patagonia (Mercerat, 1893). His work on birds was written in collaboration with Moreno, and it was published in the first volume of the new Anales del *Museo de La Plata* (1891), inaugurating a "*Paleontología Argentina*" series. This contribution was entitled "*Catálogo de los pájaros fósiles de la República Argentina conservados en el Museo de La Plata*" (Catalogue of the fossil birds preserved at the *Museo de La Plata*) (Moreno & Mercerat, 1891), with a bilingual text (Spanish and French) and magnificent plates with drawings and photographs produced by the museum print. Mercerat's descriptions of new mammal genera and species based mainly on La Plata's fossil vertebrate collection were severely criticized by G. Burmeister, Ameghino, and finally, Kraglievich (see Reig, 1962; Bondesio, 1977). However, recent reevaluations of Mercerat's works have validated some of his species and ideas (*e.g.*, Kramarz & Bond, 2008).

In the meantime, with no paleontologist in charge, in October 1893, the British paleontologist, Richard Lydekker (1849–1915), a prominent figure of its time, arrived in La Plata, invited by Moreno. Lydekker would make a second visit from July to September 1894. His main goal was to review and write about the fossil vertebrate collections of the museum, ranging from dinosaurs to mammals. However, probably Moreno's invitation intended that Lydekker checked and corrected the identifications and descriptions of the genera and species made by Ameghino and accepted or rejected them and of other taxa described by other researchers (*e.g.,* Burmeister, Mercerat) (Bondesio, 1977). Lydekker's visit resulted in its "Contributions to a knowledge of the fossil vertebrates of Argentina" published in the *Anales del Museo de La Plata* as volumes 2 and 3 (1894) of the series "*Paleontología Argentina*". With bilingual text (Spanish and English), this work was printed at La Plata with high-quality plates depicting dinosaurs, cetaceans, ungulates, edentates, and carnivores. Despite the quality of the illustrations, the text contained errors, mainly taxonomic. It was severely censured by Ameghino (1894, 1895), who attributed some of Lydekker's mistakes to the short time the author spent writing this work (Bondesio, 1977). Ameghino wrote an extensive critique of Lydekker's work in an 1895 letter to his brother Carlos, stating that

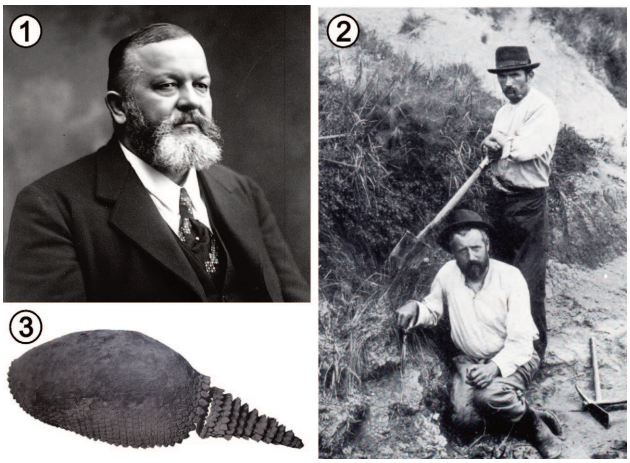

Figure 7. 1, Alcides Mercerat, chief of the Paleontology Section at the Museo de La Plata (modified from Ramos, 2023); **2,** Santiago Roth (kneeled) extracting a glyptodont, *ca.* 1890, near Pergamino (northeastern Buenos Aires Province) (modified from Weigelt, 1951); **3, *Glyptodon clavipes***, carapace and tail (modified from plate 1, Lydekker, 1894c).

"*Lydekker, como paleontólogo, ha sido arruinado por el Museo de La Plata*" (Lydekker, as a paleontologist, has been ruined by the La Plata Museum) (Reig, 1962, p.81). During his time in La Plata, Lydekker's most notable works were on the dinosaurs and cetaceans, but the exceptional quality of the plates merits a special mention. Lydekker himself wrote "The excellence of the photo-gravures with which the memoir is illustrated reflects the highest credit on the staff of the Museum, to whom the thanks of my readers and myself are due" (Lydekker, 1894a, Preface), underscoring the high printing standards of the *Museo de La Plata* at that time. Additionally, photographs of some materials and skeletons, in particular those of the glyptodonts, hold great documentary value, as many were later damaged or poorly reassembled (late 20th century), with Lydekker's plates capturing their original condition (Fig. 7.3). As Moreno's guest, Lydekker did not meet with Ameghino in La Plata, surely missing the opportunity of a profitable talk and specimen comparisons with Ameghino's personal collection. Lydekker felt that such a visit would offend Moreno, his host (Scott, 1939; Simpson, 1984; Soria, 2001). After his return to England, Lydekker (1896) published his classic work "A Geographical History of the Mammals", with a chapter on the "*Neogaeic*" (Neotropical) realm, with interesting comments, as well as drawings and photographs of fossil mammals from the *Museo de La Plata*. For those forms that Ameghino described as primitive, generalized ancestral mammals, such as the Microbiotheriidae, Lydekker correctly stated that they appeared to be "minute polyprotodont marsupials of an Australian type" (Lydekker, 1896, p. 109). Lydekker's visit revealed the importance that the *Museo de La Plata* and its collections, attained in a brief period, and the interest that it aroused in many illustrious foreign paleontologists. In addition to the other fossils, the *Museo de La Plata* collected the extraordinary mummified remains of the extinct ground sloth *Glossotherium* and other mammals from the "*Mylodon*'s Cave", making this collection one of the largest and most important in the world, being mainly collected by the German geologist Rudolph Hauthal (1854–1930), who worked for Moreno´s museum between the years 1892–1904 (see Pérez *et al.*, 2018).

In 1895, needing a qualified paleontologist, Moreno invited the Swiss Roth to become Head of the Paleontological Section of the *Museo de La Plata*, probably impressed by his skill as a fossil collector (Fig. 7.2) and his travels to Patagonia. Roth born in Herisau, Switzerland, became promptly interested in natural history collecting (Machon, 1925; Torres, 1927; Weigelt, 1951; Sánchez-Villagra *et al.*, 2023). He arrived in Argentina at age 16 and rapidly became a well-known and skillful collector, especially of Pleistocene Pampean mammal fossil remains, and for assembling and selling notable collections to European museums. One notable discovery was the "Pontimelos" or "Fontezuelas" fossil man in 1881, found near Arrecifes River (Argentina), consisting of a human skeleton beneath a glyptodont caparace, potentially suggesting the coexistence of early Americans and the extinct Quaternary Megafauna (Politis & Bonomo, 2011; Sánchez-Villagra *et al.*, 2023).

As head of the paleontological section in the *Museo de La Plata*, Roth became Carlos Ameghino's (1865–1936) antagonist as his rival collector of vertebrate fossils in Patagonia, where he found reptiles (*e.g.*, dinosaurs and turtles) and mammals from the Paleogene and from the Neogene (*e.g.*, Miocene, Collón-Curá beds). Roth supported the idea, based on the poorly known Patagonian stratigraphy, that some of the mammal-bearing beds of Patagonia were older (probably from the uppermost Cretaceous), an error later corrected, especially from the 1930s onward, due to the efforts of geologists and researchers like Simpson (Feruglio, 1949; Simpson, 1984; Bond & Deschamps, 2010). Roth described the new mammals he found in different scientific papers (1899–1903), mainly in the *Revista del Museo de La Plata*, often exchanging critiques with Florentino Ameghino. One remarkable paper (Roth, 1903) was devoted to the auditory region of South American native ungulates, where Roth recognized the order Notoungulata, grouping forms such as *Periphragnis* and *Toxodon*, and differentiating them from other South American groups such as the Litopterna, and discussing its relationships with other native ungulates (Roth, 1903). Roth's recognition of the Notoungulata as an independent order from the Holarctic ungulates ended a long debate on the relationships of these native ungulates, although Ameghino continued to place many notoungulates lineages within different Holarctic and African orders. A posthumous work by Roth (1927) on the mammalian

dentition, especially Southern ungulates, included a Spanish synopsis of Cope and Osborn's tritubercular theory, edited by Dr. Miguel Fernández (1882–1950), a recognized zoologist and also Roth's friend. A skilled expedition leader, Roth participated as a geologist in exploratory trips to Patagonia and, under Moreno's directives, in the Argentine commission surveying the border limits between Argentina and Chile (Riccardi, 2017). He also studied some fossils of the "*Mylodon* Cave", collected by Hauthal (Roth's son-in-law). An expert on Pleistocene pampean sediments, Roth (1921) wrote a classic work describing them. At the museum, he managed the display and the maintenance of the vertebrate fossil collections, making a descriptive catalog of some of the materials, such as those of the Toxodontia (Roth, 1898). His efforts led to the acquisition of exceptional specimens such as skeletons of *Toxodon*, *Macrauchenia*, several glyptodonts, and ground sloths, among other mammalian fossils. Roth cataloged the fossil vertebrate collection, and each taxonomic group was preceded by a general number, followed by specimen number; for example, the Ungulata had the collective number 12, so the skull type of *Astrapotherium patagonicum* (or "*Mesembriotherium brace*") had the collection number 12–94.

Then, in January 1906, the Museum was incorporated into the recently created *Universidad Nacional de La Plata* (National University of La Plata), with a *Facultad de Ciencias Naturales* (Faculty of Natural Sciences) and different departments, including a *Departmento de Ciencias Geológicas* (Department of Geological Sciences) directed by Roth, who became the first professor of paleontology and geology that same year.

This event deeply affected Moreno, who was proud of his creation, the *Museo de La Plata*, as an institution. In 1906, he resigned from his position as Director of the museum, and the Uruguayan archaeologist Samuel Alejandro Lafone Quevedo replaced him, holding the position until 1920. In the Departmento de Ciencias Geológicas, Roth also carried out important hydrogeological studies in different provinces under the commission of the *Museo de La Plata* (see Sánchez-Villagra *et al.*, 2023). Known for his kindness, who had once been a rival of Florentino Ameghino, later befriended him. Florentino even recognized Roth as one of the best experts on the Quaternary Pampean geology (Roth, 1921). When the Czech-north American anthropologist Alex Hrldička (1869–1943) visited Argentina in 1910 with other researchers to examine the controversial fossil human remains, Roth, along with the Ameghino brothers and Moreno, were among those who received and accompanied these foreign researchers to the sites (Hrldička *et al.*, 1912). With Roth's passing in 1924, the *Museo de La Plata* lost its principal reference on fossil vertebrates, particularly mammals. Although Roth's scientific production cannot be compared with that of Ameghino, some of his works, such as that on the auditory region of the South American native ungulates, deserve special recognition, as do his studies on the geology of the Collón Curá River, (Neuquén Province) and the Quaternary Pampean sediments.

In 1915, Dr. Eduardo Carette (?–1946) was incorporated as an Adjunct Professor in the Department of Geological Sciences under Roth, publishing two works on fossil mammals: a note on fossil mastodonts (Carette, 1919) and a study on fossil and actual Cervidae of South America (Carette, 1922). In 1911, Carette founded the *Asociación Argentina de Ciencias Naturales* (Argentine Association of Natural Sciences), which edited the scientific journal Physis, where many paleontological articles were published. From 1920 to 1932, the lawyer and archaeologist Dr. Luis María Torres (1878–1937) became the new Director of the *Museo de La Plata*. The prestigious German paleontologist Friedrich von Huene (1875–1969) was contracted to study the dinosaurs stored at the museum and undertook several trips to Patagonia (von Huene, 1929). Concerning the fossil mammals, following Roth's death, Torres hired the young and capable Argentine paleontologist Kraglievich, whose main task was to catalog the museum's fossil vertebrates Kraglievich incorporated new specimens in the catalog book using a new system of correlative numbering (Bondesio, 1977) based on the year, month, day, and specimen number, a system still used at the *Museo de La Plata* today. With the assistance of Antonio Castro, a museum preparator, Kraglievich catalogued over 10,000 specimens. Then, Kraglievich returned to the *Museo Nacional de Buenos Aires* (National Museum of Buenos Aires). Almost immediately after, Torres hired the prominent Spanish zoologist and paleontologist Cabrera Latorre, who arrived in La Plata in

1925, marking the beginning of a new epoch for Argentine vertebrate paleontology (see Reig, 1962; Bond, 2013). The *Museo de La Plata* stands as one of the foundational pillars of the Argentine vertebrate paleontology, along with G. Burmeister's museum in Buenos Aires.

After his resignation as Director of the *Museo de La Plata* in 1906, Moreno reconciled with his old rival Ameghino. Interested in the politics of helping impoverished children, he became a national deputy, advocating for educational reforms. In 1912, he promoted the government acquisition of the Ameghino collection as an invaluable patrimony for Argentine geology and paleontology. Moreno, using his income for schools and other causes, nearly losing all of his patrimony, eventually moved into a modest house in the city. Finally, on 22 November 1919, Moreno, the Argentine "*Perito*" (expert in geographical limits), the founder of the *Museo de La Plata*, died in a rented house in Buenos Aires (Ygobone, 1979; Teruggi, 1989; Fasano, 2002; Riccardi, 2019).

The journey had been long, from the private museum at the "*Edén de San Cristóbal*" to the *Museo Antropológico y Arqueológico de Buenos Aires* (Anthropological and Archaeological Museum of Buenos Aires) in the old Teatro Colón (Colón Theater), to the new *Museo de La Plata*, which in a short time gained international recognition. This legacy, despite past and present criticism (Podgorny, 1997), was undeniably the result of the iron will of one man, Francisco P. Moreno, the Argentine "*Perito*".

THE AMEGHINO BROTHERS: FLORENTINO AND CARLOS

No doubt in paleontology, the Ameghino brothers are Florentino (1853–1911), the elder and "sage" (Fig. 8.1), and the younger Carlos (1865–1936) (Fig. 8.2), the explorer and collector, who supported Florentino's endeavors for much of his life. Although involved with the two, their brother Juan (1859–1932) was almost exclusively involved within the business as administrator, mainly bookstores, that Florentino established to maintain his family and their scientific activities. The life of Florentino is well-known by the general public, as his scientific contributions are essential for paleontologists working with fossil vertebrates from the Tertiary and Quaternary of Argentina and South America. Florentino Ameghino was born in Moneglia, near Genova, Italy (then Kingdom of Sardinia and Piedmont), on September 19, 1853 (Paoli, 1960; Vanni *et al.*, 2018, Boscaini *et al.*, 2021). He arrived with his family in Luján, Buenos Aires Province, in 1854. Florentino developed his scientific career in Argentina, where he undoubtedly became a true Argentine sage. Following his studies, Florentino became a young preceptor in Mercedes, near Luján, along the Luján River. Like the Arroyo Frías, its ravines and streams were rich in fossil mammal bones, sparking Ameghino's interest in natural history and leading him to collect fossils and archaeological artifacts. Ameghino's deep knowledge of the stratigraphy of the area led him, in 1870, to discover two human skeletons in the Pleistocene layers of the Arroyo Frías, seemingly contemporaneous with extinct Quaternary fauna (Politis & Bonomo, 2011; Toledo, 2016). Ameghino enthusiastically presented these fossils to G. Burmeister at the Public Museum of Buenos Aires. However, G. Burmeister rapidly dismissed the remains, probably rudely, doubting the reliability of the finding. Ameghino felt disappointed, being this situation the genesis of his long-standing feud with G. Burmeister (see Burmeister, 1883–1892; Márquez Miranda, 1951; Podgorny, 2021; Toledo, 2022). Although the origin and the antiquity of the human species were one of the primary interests Ameghino, the new vertebrate fossils from the Miocene of Paraná collected by his friend Professor P. Scalabrini and those later collected by Carlos in Patagonia dominated his time. However, in his final years, Ameghino once again devoted his time to the study of the human fossil in South America, this way, closing the cycle. In 1875, in one of his first publications, Ameghino made a note on the Frías human fossil in France (Casinos, 2012) and, in 1877, once settled in Mercedes, Buenos Aires Province, wrote about the archaeological artifacts from Uruguay. He even pioneered photographic plates in these works, as G. Burmeister had done (Toledo, 2022). Ameghino also sent an essay on the Pampean Formation to the Sociedad Científica Argentina for a scientific contest, but it was rejected by Moreno, who disagreed with Ameghino's ideas. Although his findings on fossil humans were controversial, they garnered international interest, with the American Naturalist (1878) and European anthropologists, like Broca, examining the Frías fossils. In 1879, Florentino Ameghino traveled to France

with several important paleontological and archaeological collections to participate in the Paris Universal Exposition. There, Ameghino stayed for three years, displaying intense activity, visiting archaeological and paleontological sites, and establishing connections with important scientists (Márquez Miranda, 1951; Casinos, 2012; Podgorny, 2021). During this period, he published an article on fossil mammals of Argentina with the naturalist Henri Gervais (1845–1915), others on the human remains found by Seguin in Argentina, and archaeological instruments of France. In Paris, he married a French lady, Leontine Poirier (Toledo, 2021a). To support himself, Ameghino sold part of his collection to different people, including the prominent and wealthy North American paleontologist Edward Drinker Cope (1840–1897). He also acquired flint tools, mainly, from the Chellean industry. In Paris, he published the book "*La antiguedad del hombre en el Plata*" (Ameghino,1880) on the antiquity of humans in the River Plate area, a classic on the theme not only for specialists, but also for the general public, with several reprints in Argentina. Returning to Buenos Aires in 1881, Ameghino was informed that he had lost his teaching position in Mercedes, so he sought new income sources to maintain his family. He even produced a stenographical system, "*Taquigrafía Ameghino*", and a new cleaning product, but both were unsuccessful. As mentioned above, in 1880, Ameghino and Moreno intended to create a new National Museum. Hoping to garner government support for a national museum, Ameghino offered a donation of 4,000 pieces from his collection (of around 15,000 archaeological and paleontological pieces) to Manuel Pizarro, the minister in charge of the project. However, this project failed due to the lack of interest of the new minister, Eduardo Wilde.

In 1882, Ameghino opened a bookstore, "*Librería Glyptodon*" (Glyptodon Bookstore), on Piedras Street, later relocating it to Rivadavia (now Avenue) (Mercante, 1911; Márquez Miranda, 1951: Rusconi, 1962, 1965; Simpson, 1984: Casinos, 2012; Podgorny, 2021). He continued collecting fossils, writing to his brother Juan in July 1882 that his house was a gathering place for naturalists from the La Plata region, receiving fossils from all parts of the Republic that he scarcely had time to sort (Casinos, 2012; Podgorny, 2021).

In 1883, President Roca sent Ameghino the first dinosaur fossils discovered in Argentina, collected by the national army in Neuquén Province (Coria & Salgado, 2000), a testament to Ameghino's prominence in Argentine society. The same year, Ameghino began studying Miocene vertebrate fossils from Paraná, which was sent by professor and naturalist Pedro Scalabrini, who was actively collecting fossils to reactivate the Paraná Museum. From 1883 to 1886, Ameghino described the fossil mammals of Paraná in the *Boletín de la Academia de Córdoba* at the suggestion of

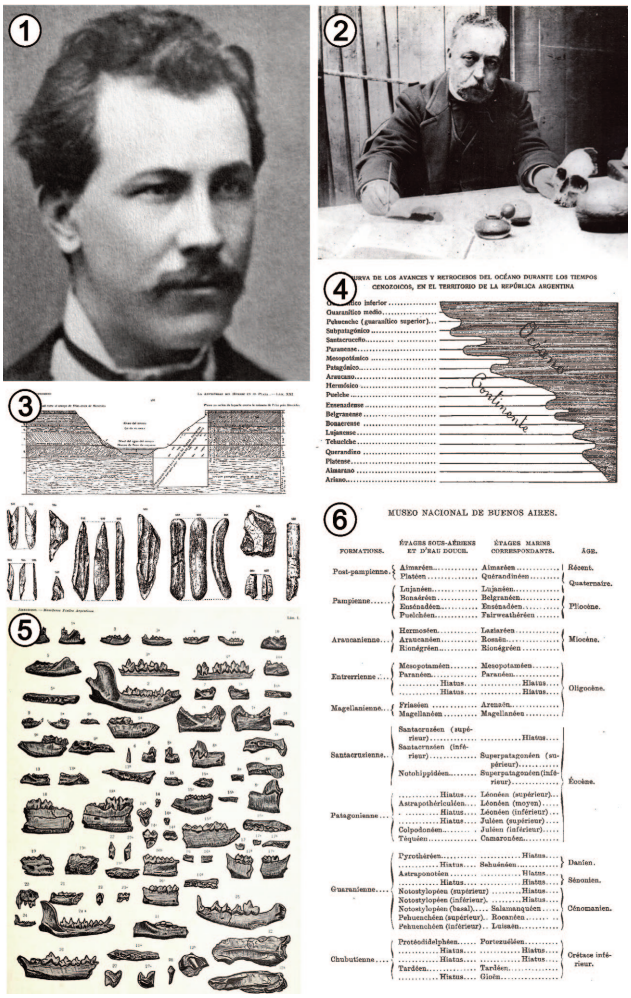

Figure 8. 1, Florentino Ameghino, *ca.* 1878 in Mercedes (modified from Orquera, 1970); **2,** Carlos Ameghino photograph from the personal collection of M. Bond; **3,** Stratigraphic profile of the Frías rivulet, fossil bones and supposed instruments made by fossil men taken from plate 21 (Ameghino, 1880) but modified from Ameghino (1918); **4,** Changes in sea levels during the Cenozoic in the Argentine Republic (Ameghino, 1889; modified from the original figure published in page 42); **5,** plate 1 modified from Ameghino (1889); **6,** The Étages of Ameghino with the equivalence of the terrestrial (subaerial or freshwater) with the marine ones (modified from original Tableau Sypnotique in page 498, Ameghino, 1906).

the Doering brothers. Among other works, some of them published in foreign journals, Ameghino (1884) published "*Filogenia*" ("Philogeny"), mainly aided by his friend Zeballos (Casinos, 2012). In the same year, he also published "*Las secas y las inundaciones en la provincia de Buenos Aires*" (The droughts and inundations in Buenos Aires Province), proposing solutions for a recurrent and cyclical problem that, despite official reprints, were never implemented. Ameghino went to Córdoba, accepting the Doering brothers' offer to lead a new anthropological and paleontological museum at the *Facultad de Ciencias Físicas y Matemáticas* (Faculty of Physic Sciences and Mathematics) at the *Universidad Nacional de Córdoba* (National University in Córdoba). Appointed professor of Zoology and an active member of the Academy of Sciences in Córdoba, he joined a failed expedition to Chaco in 1885, led by E. Holmberg and joined by C. Ameghino and, among others, the German botanist Federico Kurtz. Despite his stable friendship with Holmberg, Florentino returned early due to conflicts with him. In 1886, Moreno, Director of the provincial *Museo de La Plata*, offered him a position as Vice-Director and Secretary of the museum and Carlos as a paleontological preparator. In May 1866, Florentino resigned as a professor in Córdoba, having been awarded an honorary doctorate by the Facultad de Córdoba (Márquez Miranda, 1951; Casinos, 2012; Podgorny, 2021).

F. Ameghino arrived in La Plata, bringing part of his collection (archaeological and paleontological) and deposited it in the museum. In a well-known account, a conflict with Moreno erupted in December 1887, resulting in Florentino's resignation post and Carlos' dismissal (Fernicola, 2011a, 2011b). With his family established at La Plata, this left Ameghino in a challenging situation. However, he received support from friends, such as O. Doering, who offered to publish his works in the *Academia Nacional de Ciencias* in Córdoba. In 1887, Ameghino finished a work on Toxodontia that was intended to begin the paleontological contributions of the *Museo de La Plata*, edited by the museum. However, due to the Moreno-Ameghino conflict, it was not officially distributed until 1936, with only a few copies circulating privately.

Despite these obstacles, Florentino began to privately publish the results of the campaigns made by Carlos in Patagonia and Monte Hermoso (1887–1888), marking the beginning of the extraordinary association of the Ameghino brothers, Carlos as the field collector and keen observer, and Florentino as the fossil describer and geological interpreter (Simpson, 1948, 1984). Florentino also had the idea of synthesizing all Argentina's fossil mammals in a monumental work accompanied by an illustrated Atlas with numerous plates and figures. He aimed to present it at the 1889 Paris International Exhibition. However, he could not officially manage funds for his monumental project without his position at the *Museo de La Plata*. Once again, his good friends, the Doering brothers appeared and used their contacts to secure official support for publishing this work. This fundamental contribution to Argentine and South American paleontology, "*Contribución al conocimiento de los mamíferos fósiles de la República Argentina*" (Contribution to the knowledge of fossil mammals of the Argentine Republic), was published in 1889 as volume 6 of the *Actas de la Academia Nacional de de Ciencias en Córdoba* and was on time for the Paris Exposition.

As mentioned above, to support his family and finance Carlos's collecting campaigns in Patagonia, Florentino had a bookstore in Buenos Aires and later opened a new one named "Rivadavia", on 60th street, n° 793 in La Plata (Rusconi, 1962). The income from these libraries and some properties he owned funded all these tasks. Some fossils from his private collection were occasionally sold to foreign museums to recuperate money spent on their research. The money obtained from these sales was not used to increase Ameghino's wealth but to support his livelihood, fund new expeditions, and publish the findings. Carlos collected hundreds of specimens during his first voyage to Patagonia (Santa Cruz Province) and Monte Hermoso (Buenos Aires Province) as a collector for the *Museo de La Plata* in 1887–1888. On a second trip to Patagonia (Chubut), in 1888–1889, Carlos was accompanied by Steinfeld and Botello. Due to the conflict between Florentino and Moreno, Carlos was dismissed, but he retained some of the fossil specimens collected, which he gave to Florentino. As a result of these expeditions, Florentino described nearly 100 new mammal species from the Patagonian Tertiary terrestrial beds, currently recognized as the Santacrucian Miocene beds and the pre-Pampean or pre-Quaternary

beds of Monte Hermoso (Montehermosan, Pliocene). Previously, only about a dozen genera of fossil mammals were known from the Patagonian Tertiary. In their constant collaboration, Carlos collected specimens, and Florentino described them, although Carlos' letters from the field often contained accurate observations on the new taxa that Florentino did not always accept (*e.g.*, the avian nature of the *Phorusracus* mandible, initially attributed to an edentate by Florentino, or the marsupial nature of the *Argyrolagus* mandible that Florentino believed to be an early lagomorph) (see Bond, 2000). Carlos authored only a few papers on Patagonian geology. However, as a keen observer, he recognized during his first trip in 1887 that the rich mammal-bearing beds (currently identified as Santacrucian) were distinct and not mixed with the marine beds of the so-called Patagonian Formation. Although their exact stratigraphic position was unclear, in some places, appearing to overlap and in others to underlie the marine beds (Ameghino, 1889).

Additionally, recognizing the mammal-bearing beds as distinct from the marine ones of the then Patagonian (the latter also divided into different formations) provided the basis for distinguishing the Santa Cruz Formation as a separate terrestrial unit. Florentino recognized biochronological units characterized by their fossil mammals, which represented a time or "*Étage*", sometimes named after a characteristic fossil mammal, within larger sedimentary units known as "Formations". These "*Étages*" were later widely recognized as the "South American Land Mammal Ages" (or SALMAs), inspired by, but distinct from, the North American Land Mammal Ages (Pascual *et al.*, 1965; Simpson, 1971; Cione & Tonni, 1985). Beyond names and concepts, the development of our chronological scale for the Cenozoic (Paleogene and Neogene) of Argentina, which was later extended to South America, is the result of the pioneering work of the Ameghino brothers (Kraglievich, 1930; Simpson, 1948, 1984). During his second to sixth trips (1888–1893), Carlos recognized the new "*Étages*" ("*Notohippidén*" and "*Astrapothericuléen*") related to the Santacrucian and Patagonian "Formations", but older (see Pasotti, 1956).

With Carlos collecting in Patagonia and sending his findings, Florentino engaged in extensive research; his "*Contribución...*" (Ameghino, 1889) was awarded a prestigious Gold Medal in the Universal Exposition in Paris that year (it also earned recognition at the Chicago Exposition in 1892). Additionally, he founded a new scientific journal, the *Revista Argentina de Historia Natural*, which featured many articles by Ameghino himself and by Holmberg and Zeballos, among other collaborators. However, the journal published only one volume in 1891, and it had an adverse impact on Ameghino's finances. In 1892, following the accident and subsequent death of G. Burmeister, C. Berg was elected Director of the *Museo Nacional de Buenos Aires*, frustrating Ameghino's intention to become G. Burmeister's successor (Casinos, 2012). Between 1894 and 1895, Carlos made his seventh and eighth Patagonian expeditions, during which he discovered fossil vertebrates in beds beneath the Patagonian marine layers in the Deseado area (Santa Cruz Province). This fauna was older than the Santacruzian, *Astrapothericuléen,* and *Notohippidéen* faunas. These new beds contained rare and curious mammals, including complete remains of a strange form named by Florentino as *Pyrotherium*, previously known only by isolated teeth. Florentino named these new beds the "*Étage Pyrotheréen Étage*" (currently known as the Deseadan SALMA; Oligocene) (Ameghino, 1895, 1897). For Ameghino, the most important aspect was that these fossils came from levels of the "Formation Guaranienne", believed to be, at that time, Uppermost Cretaceous or Lowermost Tertiary. These discoveries drew considerable attention from international scientific circles and museums, awakening the interest in Patagonian fossil vertebrates (see Simpson, 1948, 1984). This interest led the skilled North American collector John Bell Hatcher (1861–1904) to make three expeditions to Patagonia (1896–1898), collecting fossils for Princeton University (Simpson, 1984). Hatcher did not agree with Ameghino's interpretations of the great ages of the formations, and although their relationships were not always in good terms, Ameghino respected Hatcher's fieldwork. Hatcher visited Carlos in Santa Cruz, and Florentino at his house in La Plata, requesting details about the fossil sites. However, Ameghino did not give him precise information, telling von Ihering in an 1897 letter, "*Si quieren materiales que los busquen*". (If they want materials, they have to look for them) (Casinos, 2012, p. 260). In those years, Ameghino sold to the British Museum a large collection of the gigantic

Phorusrhacidae birds, making also arrangements with the Museum of Munich and the German paleontologist Karl A. von Zittel (1839–1904), selling to this institution, fossils from Patagonia (Zittel, 1925). However, much of the collection was later destroyed during World War II.

Florentino displayed a prolific scientific, educational, and philosophical career during this time. In 1897, he was named professor of Geology and Mineralogy at the *Facultad de Ciencias Físicas y Matemáticas* (Faculty of Physical and Mathematical Sciences) in La Plata. He was elected Academic Member of the provincial University. His numerous works, published in the *Boletín de la Academia de Ciencias de Córdoba*, *Anales de la Sociedad Científica Argentina*, *Anales del Museo Nacional de Buenos Aires*, and other foreign journals, reflect his enormous productivity and the wide scope of his research.

In 1898, Carlos made his ninth expedition. He began collecting in the "*Gran Barranca*" (Great Barranca) at Lago Colhué-Huapí in central Chubut Province, one of the most renowned sites in Patagonia, where a notable rich succession of "*Étages*" were distinguished (Simpson, 1948, 1984; Madden *et al.*, 2010). This area was also exploited by the French collector André Tournouër (1871–1929), who worked in Patagonia from 1898 to 1903. Tournouër had a friendly relationship with Carlos and Florentino, and he sent his collection to the Museum of Paris, where some specimens were studied by the French paleontologist Jean Albert Gaudry (1827–1908) and published in different contributions (Simpson, 1948, 1967, 1984). On his tenth journey (1898–1899), Carlos wrote to Florentino that he could identify a lower mammalian fauna at Colhué-Huapi, representing a new and more ancient "*Étage*" below the "*Pyrotheréen*", which Florentino subsequently named the "*Notostylopéen*" after the characteristic notoungulate genus *Notostylops* (Ameghino, 1900–1902, 1906; Simpson, 1948, 1984). This new level (the Casamayoran, Vacan and Barrancan, SALMA; Eocene), more ancient than the "*Pyrotheréen*" was undoubtedly considered by F. Ameghino Cretaceous (Cenomanian) in age, since in those beds Carlos found serrated reptilian teeth resembling those of theropod dinosaurs, reinforcing Florentino's idea about the age of these beds and the contemporaneity of its mammals with the dinosaurs (see Ameghino, 1906). Ameghino observed that the new mammals described from these beds, supposedly Cretaceous, were more complex and derived than the Cretaceous mammals known by then from North America. This indicated that southern faunas were more advanced than the northern ones and that Patagonia might have been a center of origin for mammalian orders on other continents. However, after Florentino and Carlos's deaths, the supposed dinosaurian teeth, which had supported the Cretaceous dating of the "*Notostylopéen*" (or Casamayoran), were later demonstrated to belong to the peculiar extinct Tertiary Sebecidae crocodiles, whose teeth resembled those of theropods (see Colbert, 1946; Bond, 2000). Almost simultaneously, S. Roth of the *Museo de La Plata* collected mammals in beds near others with dinosaurs, but the exact position of these was unclear, so Roth labeled many collected mammals as coming from the Upper Cretaceous from the "Musters", which was the Colhué Huapi Lake. Roth intentionally misidentified the lake to prevent Carlos from collecting in the same places, which did not work (see Simpson, 1967; Bond & Deschamps, 2010).

In his last expeditions to Patagonia (1900–1903), Carlos collected fossils that allowed Florentino to recognize two new mammalian faunas, the "*Colpodonéen*" and the "*Astraponotéen*" "*Étages*", currently recognized as the Colhuehuapian (Oligocene–Miocene) and Mustersan (Uppermost Eocene) SALMAs. In 1901, the renowned North American paleontologist William Berryman Scott (1858–1947) visited Florentino Ameghino (Scott, 1939) in La Plata, studying and photographing his fossil collection, which was by then stored at his house (see Simpson, 1984; Vizcaíno *et al.*, 2017). Scott also visited the La Plata and Buenos Aires museums. He studied many of the fossil mammals collected by Hatcher in a series of magnificent volumes published between 1903 to 1932 and in his book "A History of land mammals in the Western Hemisphere" (Scott, 1913, 1937). Scott's visit and comments on his relationship with Ameghino (Scott, 1939) illustrated the high regard Ameghino had earned nationally and internationally (see Casinos, 2012).

In 1902, Florentino was appointed Director of the *Museo Nacional de Buenos Aires* and designated Carlos as a traveling naturalist. In 1903, Florentino made his final trip to Patagonia, but now on behalf of the Museum of Buenos

Aires (see Simpson, 1948, 1984). Florentino made his first and only trip to Patagonia as a warm and fraternal action, where both brothers visited some of the main collecting places.

As Director of the *Museo Nacional de Buenos Aires*, Florentino continued publishing his significant studies, especially in the *Anales del Museo Nacional de Buenos Aires*, on diverse topics, such as fossil penguins, tarsal morphology of fossil mammals, molar morphology of the fossil ungulates ("*Recherhes de morphologie phylogenetique...*"; Ameghino, 1904), as well as the magnificent synthesis on Patagonian geology and its fossil faunas, "*Les Formations Sédimentaires du Crétacé Superieur et du Tertiaire de Patagonie...*" (Ameghino, 1906). At the museum, Ameghino hired the preparator Santiago Pozzi (1849–1929) (Laza, 2019) and, in 1903, designated the Argentine anthropologist Juan Bautista Ambrosetti (1865–1917) as chief of the archaeological section. Ambrosetti, son-in-law of Ameghino's friend Holmberg, Ameghino's friend, had worked on paleontology in Entre Ríos Province with Scalabrini. He became the director of the new Ethnographical Museum of Buenos Aires in 1906, which housed some pieces of Ameghino's archaeological collection. That same year, Florentino was designated professor of Geology and an academic of the *Facultad del Museo* de *la Universidad Nacional de La Plata* (Casinos, 2012; Podgorny, 2021). He also advocated for a new building for the old museum, which was still at the "*Manzana de las Luces*" and only obtaining some rented properties to expand the space.

In 1908, Florentino made several trips to the Atlantic coast of Buenos Aires, near Mar del Plata and Chapadmalal, and published a work describing the geology of the cliffs and the fossil fauna. He recognized as new geological horizon, called "Chapalmalense" (Ameghino, 1909), currently the Chapadmalal Formation. Although Ameghino's "Chapalmalense" included additional horizons now recognized as Barrancalobian and others of Lower Pleistocene age (Cione *et al.*, 2015), he correctly inferred that the Chapadmalal sediments differed from those at Monte Hermoso and lay between that horizon and the Pampean beds (Pliocene and Pleistocene).

In the last years, before his death in 1911, Ameghino revisited his early interest in the study of fossil humans. As Simpson (1948) wrote, Florentino's first works from 1875 to 1882 and the latest from 1907 to 1911 were mainly on fossil man, its artifacts, and the stratigraphy related to its antiquity, being the intermediate period from 1883 to 1906, dedicated to the study of the Cenozoic fossil mammals. The impact of his paleoanthropological findings was significant: his discoveries, such as the atlas from Monte Hermoso and the fossils like *Diprothomo*, raised interest, resulting in over 150 papers by Ameghino and other researchers from 1900 to 1932 (Castellanos, 1937). In 1910, the Czech-American anthropologist Aleš Hrdlička from the Smithsonian Institution visited Argentina with some collaborators to examine the reputed fossil human remains found here, some attributed by Ameghino to the Tertiary and Quaternary. They were received by Moreno, Roth, Florentino and Carlos Ameghino. Disagreeing with Ameghino's theories of a South American origin for humans, Hrdlička supported the Asiatic origin, via Beringia, of the early American indigenous people. After their work, they concluded that the fossils examined showed no substantial differences from contemporary indigenous tribes living in South America (Hrdlička *et al.*, 1912). This outcome challenged Ameghino's theories on human antiquity and evolutionary origins. Nonetheless, later research verified that some discoveries, such as the Frías skeleton, were from the Late Pleistocene, though not as ancient as Ameghino had originally proposed (see Politis & Bonomo, 2011). Additionally, Ameghino's hypothesis that human evolution could have originated from fossil primates like *Homunculus* from Patagonia, which were later confirmed as platyrrhine primates, was also refuted.

AMEGHINO AND ITS AFTERMATH

Florentino Ameghino died in La Plata on August 6, 1911, and his Civic Funeral was on September 18. He was honored by the principal personalities of that time, including the French socialist politician Jean Jaurés (1859–1914), who was visiting Argentina and had planned to visit the Paleontological Section of the *Museo de La Plata* (Torcelli, 1913–1935; Casinos, 2012). This tribute shows the remarkable impact of Florentino Ameghino.

Despite criticisms surrounding Florentino Ameghino, his legacy remains extraordinary, as much of his scientific

work has established him as an essential pillar of Argentine paleontology. Between 1875 and 1911, he wrote at least 181 articles, among monographic and other unpublished works (see Torcelli, 1913–1935; Mercante, 1911), F. Ameghino's contributions are noteworthy, including his description of many new vertebrate fossil taxa, mainly mammals, and his observations on the stratigraphy and geochronology of Argentina. Although F. Ameghino made mistakes in some descriptions and/or interpretations (as Simpson, 1984, p. 93, said "as who does not?"), such as the case of *Arhinolemur* from the Miocene of Paraná, the first lemuriform primate, then as a transitional form between reptiles and mammals (Ameghino, 1898, 1899), and later recognized as a fish. This is the reason why Ameghino omitted any other ulterior mention on this "extraordinary and intermediate" fossil (see Simpson, 1945; Bogan *et al.*, 2012). This curious example reflects Ameghino's occasional tendency to prioritize his phylogenetic interpretations. Despite his keen observational skills, Ameghino was not an anatomist expert like G. Burmeister.

Any paleontologist working on South American Tertiary and Quaternary geology and paleontology has undoubtedly read Florentino's works, as they provide indispensable insights. Ameghino's contributions hold scientific and historical value. If we have to choose just a few of his significant scientific production in order to illustrate his influence in our discipline, from a personal point of view, I would select the following: "*La antiguedad del Hombre en el Plata*" (Ameghino, 1880); "*Filogenia*" (Ameghino, 1884); "*Contribución al conocimiento de los Mamíferos Fósiles de la República Argentina*" (Ameghino, 1889); "*Recherches de Morphologie Phylogénétique sur les molaires supérieures des Ongulés*" (Ameghino, 1904); and "*Les formations sédimentaires du crétacé supérieur et du tertiaire de Patagonie avec un paralléle entre leurs faunes mammalogiques et celles de l'ancien continent*" (Ameghino, 1906).

The first, "*La Antigüedad del hombre en el Plata*" (The Antiquity of Man in the Plata), published in Spanish and edited in Paris and Buenos Aires in 1884, presents an early synthesis of his paleoanthropological studies dating back to 1875. In the prologue, F. Ameghino stated his aim: to demonstrate that humans coexisted with the extinct giant fauna in the Argentine Pampas, such as the megaterids and others. He also acknowledged the contributions of those interested in the antiquities of our territory, including Zeballos and Moreno and his *Museo Antropológico y Arqueológico de Buenos Aires*.

After an introduction and discussion on different chronological, anthropological, and historical aspects of the pre-Columbian civilizations, showing that he had consulted a wide range of bibliography on the topic and engaged with ideas of ancient connections between different civilizations, as the Maya and the Egyptians, among others, as well as theories of lost land connections/bridges. He also discussed the Quaternary Pampean Formation and its genesis, providing an excellent synthesis of these ideas (*e.g.*, Bravard and Burmeister). He acknowledged G. Burmeister's accuracy in his idea of the Pampean beds' mixed origin (fluvial and eolian), aligning with his opinion. Then, Ameghino reviewed what was known about fossil humans in Argentina then, describing his findings in different places in the vicinities of Luján and Mercedes, including the Arroyo Frías fossil human site. He provided its stratigraphy, the fossil faunal remains found in those sites, including purported human-made tools and worked bones (Toledo, 2021b). The book is illustrated with fascinating plates (Fig. 8.3), with many figures depicting the instruments and fossil bones with marks attributed by Ameghino to the action of ancient man. With all justice, this work can be considered an invaluable source of information and a landmark in the history of Argentine archaeology and paleoanthropology. While some of Ameghino's conclusions were later proven incorrect, the confirmation of the Late Pleistocene age of the Frías fossil human and the rediscovery of artifacts and marked bones, originally studied and illustrated by Ameghino (Toledo, 2021b; Simón *et al.*, 2023) brought renewed interest and value to "*Antiguedad*" (see Toledo, 2011, 2016; Casinos, 2012; Podgorny, 2021; Simón *et al.*, 2023). Upon its publication, this highly readable book found success among specialists and the general public, posteriorly reimpressed in popular editions, as the 1918 reprint by "*La Cultura Argentina*". This reflects the general cultural interest in Argentina's ancient human, their origins, and the antiquities of America.

The second work chosen, "*Filogenia. Principios de Clasificación Transformista basados sobre Leyes Naturales y*

Proporciones Matemáticas" (Phylogeny. Principles of a transformist classification based on natural laws and mathematical proportions), was published in Buenos Aires in 1884, with an important financial support of his friend Zeballos (see Casinos, 2012). Its title reflects its content. Undoubtedly, Ameghino's main work explains the conceptual and theoretical principles he used in the morphological and taxonomical analyses of mammalian relationships. In the prologue, Ameghino discussed extinct ungulates, such as *Toxodon* and *Typotherium,* noting the difficulty of including them within existing classifications due to their unique characteristics and the inadequacies of prior classificatory systems. He aimed to apply a new methodology he named "mathematical zoology", to achieve an objective classification of the living beings. Conscious of the challenge, Ameghino stated that his critics would probably disqualify him as a madman. In "*Filogenia*", Ameghino also included his 1882 conference, "*La Edad de la Piedra*", where he paid tribute to Darwin by describing transformism as an exact science. The proposed new methodology, based on mathematical principles, was intended to establish a non-subjective classification, as Ameghino believed that since the apparition of Darwinism and the evolutionary theory in biological sciences, a new zoological classification was necessary. Throughout the book, different methods and principles were described, showing how some of them, such as the number of teeth and/or the reduction of digits, would provide an exact method to classify the taxa, understanding their relationships with other forms. Despite Ameghino's idea that the book would impact taxonomy and phylogeny, it had no effect in contemporary taxonomical studies except in Ameghino's works (Simpson, 1984). In a good analysis of "*Filogenia*", Casinos (2012) showed Haeckel's influence, notably in the trees that Ameghino used in his later works. However, it may be an exaggeration to interpret Ameghino's phylogenetic schemes as precursors to cladistics. On the other hand, Soria (2001) argued that in "*Filogenia*", Ameghino proposed a methodology for genealogical classifications and consider him a pioneer in evolutionary systematics. Soria (2001) also commented that Ameghino, in his seriation method, ordered the groups in a presumed evolutionary succession, suggesting the idea that unknown intermediate forms could be predicted with mathematical precision, despite the inherent difficulties. In his study of horse evolution, Ameghino recognized at least 41 intermediate stages between the earliest forms and the modern genus. In human evolution, Ameghino recognized some theoretical intermediate forms, such as *Diprotohomo* and *Tetraprothomo*, which he will later claim to discover and describe (Hrldička *et al.*, 1912; Casinos, 2012). Not less important, in "*Filogenia*", Ameghino developed a curious concept determinant in his ideas on the classification and evolution of the mammalian orders. In the first chapter, "Imperfections and deficiencies of the actual classifications", Ameghino wrote, that despite the accepted the idea of classifying living mammals into three groups characterized by their reproductive system (the "ornitodelfos" or monotremes; the "didelfos", metatherians or marsupials; and "monodelfos" or eutherians), that the marsupial stage of the didelfians should not be considered an "independent natural group", but rather a stage in the reproductive development. Ameghino supported this rejection also by stating that the "monodelfians" or eutherians had "extreme modifications" of primitive "didelfians" types, grouping animals, such as tigers, lions, and dogs, along with the *Thylacine* (marsupial wolf) and dasyures. This idea of phylogenetic links between metatherians and eutherians, with one ancestral to the other, is unique and distinctive of Florentino Ameghino's evolutionary and classificatory schemes (Simpson, 1984), as at that time marsupials were sometimes considered derived from eutherians, rather than ancestral to them. "*Filogenia*" is a book on evolution and it was unusual for the Argentine society of that time, suggesting there were people interested in this topic (despite Simpson, 1984). Its publication was noted in leading newspapers, including an extensive and enthusiastic article by Bartolomé Mitre in "La Nación". Holmberg (1884) critiqued Ameghino's "*Filogenia*", discussing if mathematics was a proper method to apply in taxonomy, disapproving Ameghino's rejection of all previous classificatory systems, while acknowledging some aspects of Ameghino's ideas (Holmberg, 1884; Podgorny, 2021). The importance of "*Filogenia*" to Ameghino can be seen in a letter he wrote to the Minister Wilde, reporting the book's publication and mentioning that it

would keep "*bien alto el nombre científico de la República Argentina*" (very high the scientific name of the Argentine Republic) (Márquez Miranda, 1951, p. 254). He also complained about the high cost of the edition and suggested that government support might be secured through a subscription. From many points of view, this theoretical book is outstanding; probably not as accessible to the general public as the "*Antigüedad…*", "*Filogenia*" which had many reeditions in different editorial houses, showing the interest in this curious "evolutionary or transformist book".

The third work, "*Contribución al conocimiento de los mamíferos fósiles de la República Argentina*" (Ameghino, 1889), appeared as volume VI of the *Actas de la Academia Nacional de Ciencias de Córdoba*, printed on May 20, 1889, with Peuser (Buenos Aires) and Masson (Paris) as editors. It was written in nearly 18 months and supported by official funding; it was awarded a gold medal at the 1889 Universal Exposition in Paris. The prologue acknowledged numerous individuals who positively contributed to the book pointing to F. P. Moreno as someone who made all efforts against its publication. Given the conflict between Moreno and Ameghino, a series of letters and documents regarding this issue followed (Ameghino, 1889; Márquez Miranda, 1951; Casinos, 2012; Fernicola, 2011a, 2011b; Podgorny, 2021), showing how this matter affected Ameghino. Undoubtedly, the "*Contribución…*" represents a monumental work that alone would place Florentino Ameghino as a remarkable figure in Argentine vertebrate paleontology. The text, with over a thousand pages (1008), began with a historical synthesis and comments on zoological nomenclature applied to Paleontology. This is followed by a geological summary of the Tertiary and Quaternary, mainly based on Doering´s scheme, but expanded with new "*Pisos*" or "Stages", increasing to 20 from Doering's 14 in 1880, representing a significant advance in the understanding of the Argentine stratigraphic succession at that time. In the "Eogeno", the "Formación Guaranítica" was a mixture of "*Pisos*" or "Stages" referred to the Cretaceous and to the "Palaeoceno", as the upper Stage or "Pehuenche" had fossil mammals like *Pyrotherium* alongside dinosaurs. Although the exact relationship between the dinosaur and mammal fossil beds was unclear, they were considered contemporaneous. A new "*Piso*" named "Santacruzeño" (now known as the Santacrucian SALMA) was characterized by mammals identified by Ameghino as multituberculate Plagiaulacidae and carnivorous Creodonta (now Caenolestidae and Sparassodonta metatherians) within the "Santacruzeña" Formation, which rich in fossil vertebrates, especially mammals (*e.g. Nesodon* and *Astrapotherium*) (Fernicola *et al.*, 2019).

As observed by Carlos, the position of the "Santacruzeño" beds was unclear relative to the marine "Patagónico", in some areas, apparently overlying marine beds with *Ostrea*, while in others, they underly marine beds identified as "Paranense", "Mesopotámico", or "Patagónico". Thus, in the "*Contribución*", the "Santacruzian" appeared inverted beneath the Patagonian coast, marine beds, with the distinction that the "Santacruzeño" mammals like *Nesodon* were not mixed with the marine faunas as in earlier geological schemes. Ameghino also recognized the "Hermósico" stage for Monte Hermoso above the Araucanian, and in the "Pampean" (considered to be Pliocene), from older to younger, he used the names: Ensenadan, Belgranian, Bonaerian, and Lujanian, all of which are still in use today, except for the Belgranian.

The book included a figure (Fig. 8.4), illustrating the advances and retreats of the ocean during the Argentine Cenozoic, a pioneering interpretation of sea level changes over time and their relation to different sedimentary formations in Argentina (Ameghino, 1889). Following this exceptional geological synthesis, particularly on "Pampean" sediments, the work continued with remarkable authority on fossil humans and descriptions of mammalian taxa, many of them new. Ameghino noted that of the 570 species of mammals mentioned, 450 were new. Ameghino methodically described each taxon (genus or species), discussing their relationships (at the ordinal and/or familiar level) using the methodology from "*Filogenia*", including diagrams (dichotomic or trichotomic) for orders, genera, and species. In the text and diagrams, Ameghino used theoretical forms that had not yet been discovered. Additionally, as pointed out in "*Filogenia*", it is challenging to establish direct ancestral or kinship relationships between metatherians and eutherians. For instance, while discussing Carnivora, Ameghino considered a primitive Mesozoic mammal (*Phascolotherium*) as an ancestral form in his

relationships diagram. He also positioned the dasyuran carnivorous metatherians as a sister group of eutherian Carnivora. On the other hand, based on dental similarities, he included the Santacrucian extinct Sparassosonta (now metatherians) within Creodonta, a group of primitive carnivorans, an interpretation some European authors subsequently adopted. One thing we must consider in many Ameghino's phylogenetic interpretations is that he considered every anatomical similarity as an indicator of a close relationship, often overlooking the possibility of convergence or homoplasy. This is particularly evident in his interpretation of South American native ungulates as being related to, or ancestral to, ungulates from other regions. However, these shortcomings do not overshadow the monumental, encyclopedic nature of Ameghino's work, which is not merely a compilation but a contribution that describes and names numerous new taxa. Detailed diagnoses of species, genera, families, and major groups are given, along with anatomical descriptions, making Ameghino's work unparalleled, encapsulating all knowledge of both fossil and extant mammals of Argentina (and beyond) and their relationships. The work ended with comparing extinct faunas and a "*Suplemento*" (Supplement) with additional observations and descriptions of new species. Hundreds of new species, many from Patagonia, Monte Hermoso, Paraná, and other sites, expanded the knowledge of Argentina's extinct faunas and laid the foundations for Ameghino's phylogenetic schemes, inaugurating biostratigraphic and biochronologic successions that would lead to his final geochronological scheme, or "*étages*". Although Ameghino was excluded from the *Museo Público de Buenos Aires* by G. Burmeister and from the *Museo de La Pata* by Moreno, he continued with this work with the support of O. Doering and the Academy of Córdoba, which aided in printing and disseminating the work despite the political issues that sometimes disrupted official support Florentino also use personal incomes for editing the book. A massive Atlas of 98 plates accompanied the text and numerous figures (Fig. 8.5); some of these plates had more than 30 drawings in different views. Although many of the drawings were not of the quality seen in the plates of G. Burmeister's *Anales del Museo Público de Buenos Aires*, they were good enough for the described specimens. These plates were produced by the "*Compañía Sudamericana de Billetes de Banco*", one of the best printing companies at that moment, and mainly drawn by Zacarías Bommert, Ameghino's friend (see Simón *et al.*, 2023) within eight months for near-daily work. Despite contemporary critiques (see Burmeister, 1883–1891) and modern comments (Podgorny, 2021), the "*Contribución...*" remains essential, and all paleontologists that focus their work in the Cenozoic South American mammalian faunas recognize it as an extraordinary work that positioned Ameghino as a founding figure in Argentine paleontology.

The other notable work is the "*Recherches de Morphologie Phylogénétique sur les molaires supérieures des Ongulés*", published in 1904 in the *Anales del Museo Nacional de Buenos Aires*, although focused on a specific group, the South American native ungulates. In this work, Ameghino illustrated many species he had previously described but not figured out, and he synthetized his dental evolution ideas. He rejected Cope's tritubercular theory, proposing instead that tooth complexity developed through an accretion of conules, forming a nearly quadritubercular structure. Ameghino also suggested that brachydont teeth, in some instances, were a modification of hypsodont teeth rather than the way around. Most remarkably, he interpreted that some Tertiary mammals, such as the toxodonts from the Santacrucian (Miocene), presented three dental replacement series instead of the two (deciduous and permanent) normally accepted, indicating that more deciduous series represented an ancestral state. Ameghino even proposed multiple replacement teeth for carnivorous marsupials. Other researchers did not accept these ideas; for example, Scott, who studied the Santacrucian Toxodontidae and did not endorse Ameghino's ideas after having examined the materials. Despite this, the work remains significant concerning the relationships of the studied South American native ungulates (*e.g.*, litopterns, astrapotherians, and toxodonts). Ameghino accurately and skillfully resolved inter-generic and some familial relationships. However, his interpretations at the supra-familial or ordinal level often suggested links to Holarctic or African taxa, positing greater antiquity for South American lineages as ancestral forms. Despite its now outdated theoretical foundations, the "*Recherches...*"

remains a valuable reference for those paleontologists studying South American native ungulates.

The last selected work, "*Les Formations Sédimentaires du Cétacé Supérieur et du Tertiaire de Patagonie avec un paralléleentre leurs faunes mammalogiques et celles de l'ancien continent*", was published in 1906 also in the *Anales del Museo Nacional de Buenos Aires*. As mentioned, foreign scientific circles strongly criticized Ameghino's interpretation on the relationships of mammals and the inferred antiquity of fossil-bearing strata. Ameghino's geological synthesis of Patagonia was initially published in different fascicles from 1900 to 1902 in the *Anales de la Sociedad Científica Argentina* (Ameghino, 1900–1902). In 1905, the German geologist Otto Wilckens (1876–1943) wrote a paper on the marine beds of the Cretaceous and Tertiary (with marine fossils, invertebrates, sharks, and fishes) of Patagonia, examining not only the Patagonian marine beds but also the mammalian fossil beds, criticizing Ameghino's inferred ages. In response, Ameghino produced "*Les Formations Sédimentaires...*" (The sedimentary formations...), a superb work of 568 pages, which synthesized all that was by then known of Patagonian geology from the Cretaceous (with dinosaurs) and Tertiary (with marine fossils, invertebrates, sharks, and fishes), the biochronological faunal successions, and a broad view of the vertebrate faunas present in the Patagonian beds, mainly the mammalian ones, with comparisons with the faunas from other continents. Simpson (1984, p. 88), reviewed F. Ameghino's production and stated "it is the most instructive and for many purposes the most useful...".

The text included numerous figures, some illustrating previously unpublished specimens, along with rudimentary but useful maps and profiles, with the distribution of each "Formations" and "*Étages*" (Stages), summarizing the latter with its principal characteristics, geological context, sedimentological aspects, and fossil content. Florentino Ameghino examined the relationships between some non-South American fossil mammal faunas with those of Argentina, the hypothesized ancient connections between America, Africa, and Europe, and discussed the influence of marine barriers in faunal distribution. He also discussed the geological and geographical distribution of fossil mammals in Patagonia, providing faunal lists of his "*Étages*" and the temporal distribution of the different families. The final part also examined the interrelationships between marine and terrestrial "*étages*" (Fig. 8.6).

"*Les Formations...*" (The formations...) represents the final synthesis of the biochronological scale that would become the basis for the *reconnaissance* of the South American Land Mammal Ages and establishing a provincial South American temporal or biochronological framework (Pascual *et al.*, 1965). For Ameghino, this mammal-based biochronological subdivisions or "*Étages*" were true "*chronometres géologiques*" (geological chronometers) (Ameghino, 1906, p. 20). In one section in which F. Ameghino described the geological distribution of mammals in Patagonia and their relationships with similar forms related or supposedly related from other continents, it is necessary to highlight, as already pointed out by Simpson (1948), that F. Ameghino was a keen observer of the morphological differences, but sometimes overestimated its significance resulting in an inflated taxonomy of genus and species, describing new taxa that now are interpreted as individual variations. For example, several specimens of the notoungulate *Henricosbornia lophodonta* from the Casamayoran Eocene were categorized by F. Ameghino in at least three different orders and four families. As mentioned, despite this tendency toward a "splitting" taxonomy, F. Ameghino's interpretations of inter-familial and inter-generic relationships were generally accurate. However, this cannot be extrapolated to ordinal relationships. This led F. Ameghino to a dual phylogeny wherein South American group similarities were generally accurate, while comparisons with Holarctic or African groups proved more problematic or wrong. Of course, F. Ameghino didn't know it, but South America exemplifies homoplasy on a grand scale, and here, many mammal lineages evolved adaptive radiations closely resembling unrelated Holarctic or African ones. As Simpson (1948, p. 23) pointed out "The only key to this great, complex puzzle is homoplasy, and Ameghino did not use this key". Interestingly, F. Ameghino briefly considered this possibility in his 1906 work but dismissed it shortly after, convinced of the South American origin of all the mammalian lineages. As an example, F. Ameghino believed the Polydolopidae were related to caenolestids and multituberculates, though now we know

that Polydolopidae are metatherians related to caenolestids and unrelated to the Multituberculata (Simpson, 1948). In "*les Formations...*" such examples abound, and as we noted in "*Filogenia*" (Phylogeny), F. Ameghino did not consider marsupials or metatherians as a separate group from placentals but as intermediate or primitive relatives. For example, F. Ameghino considered the extinct bunodont Caroloameghinidae marsupials to be ancestral to the generalized "ungulate" condylarths, or the still-living Microbiotheriidae marsupials as related to Polydolopidae marsupials and thereby to Rodentia (see Ameghino, 1903). In another example, the South American native ungulate Pyrotheria was considered related to the African Proboscidea, or some notoungulates, as well as African Hyracoidea. Regarding the origin of humans, Ameghino placed the ancient relatives of primates, the Microbiotheriidae marsupials, at the base of his phylogenetic tree (Fig. 9). Despite these now-outdated phylogenetic relationships for some mammalian groups, "*Les Formations...*" remains as one of our reference books for the biochronological framework of the South American

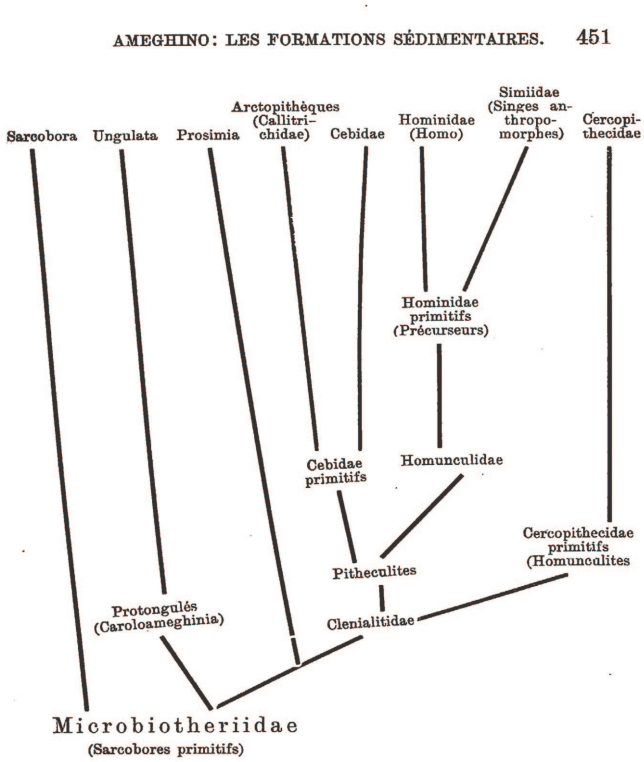

Figure 9. Phylogenetic relationships of the Primates (modified from page 451, Ameghino, 1906).

mammalian evolution and also as outstanding review of the Patagonian geology.

THE SIGNIFICANCE OF F. AMEGHINO'S WORK

These selected works of F. Ameghino, drawn from his vast publications, are more than enough to understand why he occupies such a prominent place in the development of our science as a figure recognized in the scientific circles of that time in Europe and North America, and an example for the rest of South America. We owe much of our knowledge of many fossils of vertebrate genera, especially mammals, to Florentino's descriptive and interpretative work. Despite the reinterpretations, corrections, and critiques of his studies, his monumental contribution to the biochronological scale for Argentina endures (undoubtedly aided by Carlos, whose collections and observations were crucial to Florentino's work). As Simpson (1984, p. 93), one of the first to fully appreciate Carlos' role, noted "The partnership of the Ameghino brothers was an outstanding example of teamwork, and their achievement was one of the most remarkable in scientific history". Finally, F. Ameghino was recognized and respected even by his critics, renowned in foreign scientific circles of North America and Europe. His work was referenced by notable scientists, such as Cope, Scott, Lydekker, Gaudry, and Zittel, among others, and his works were cited in many significant books of the late 19th and early 20th centuries, such as Flower & Lydekker (1891), Lydekker (1896), Gregory (1910), and Zittel (1925). Undoubtedly, Florentino was instrumental in worldwide recognizing the Argentine vertebrate paleontology.

AFTER F. AMEGHINO

Following F. Ameghino's passing, the naturalist Ángel Gallardo (1867–1934) assumed as the Director of the *Museo Nacional de Buenos Aires* from 1912–1916 (Lascano González, 1980). Gallardo, though not a vertebrate paleontologist, oversaw a period in which the museum collaborated with the *Museo de La Plata* in studying and collecting fossils from the cliffs of Chapadmalal and Miramar, which were linked to the controversial fossil human discoveries there (Tonni *et al.*, 2001; Bonomo, 2002). Agustín G. Péndola (1841–1936), Secretary of the Museum,

served as Director from 1916–1919, and then C. Ameghino, who had been in charge of the Paleontological Section since 1917, was appointed as Director from 1919–1923 (Lascano González, 1980). During these years, the Argentine vertebrate paleontology continued to be studied in the *Museo de La Plata* and the *Museo Nacional de Buenos Aires*. In contrast to the *Universidad Nacional de La Plata* (see above), the discipline at the *Museo Nacional de Buenos Aires* was maintained by self-taught people, encouraged and protected by C. Ameghino, who worked with a certain reverence for the figure of Florentino and were resistant to critiques to his work (see Cabrera, 1944; Reig, 1962). These figures would become leading proponents of the discipline: Lucas Kraglievich, Carlos Rusconi (1898–1968), Alfredo Castellanos (1893–1975), and the skilled preparator Lorenzo Julio Parodi (1890–1969), all working at the Museum until 1930 (Cornero & Tonni, 2023).

Additionally, we must mention the Italian geologist Gaetano (Cayetano) Rovereto (1870–1952), who worked in Argentina for several years, focusing on geomorphology, Quaternary studies, and paleontology. Rovereto collaborated with C. Ameghino at the *Museo Nacional de Buenos Aires* and published a study on fossil crocodiles of the Paraná Miocene ("*Mesopotamiense*") in the *Anales del Museo*. In 1914, and the volume 25 of the same series, Rovereto published a large and classic study of the Neogene fossil-bearing "Estratos Araucanos", which included the "Rionegrense", "Araucaniano", "Hermoseano", and "Chapalmalense". These were initially to the Pliocene, but are currently considered to span from the upper Miocene to the upper Pliocene (Cione *et al.*, 2015). For Rovereto, the South American vertebrate faunas found in older beds than the Araucanian were autochthonous, probably due to isolation since the Cretaceous. Interestingly, he noted affinities between some Araucanian taxa and those from Europe and Africa, possibly related to a hypothetical Guyano-Senegalan bridge, and recognized North American affinities in some of the land mammals of the Pampean Quaternary beds. Rovereto reviewed many known vertebrate species and described several new ones. The text was accompanied by numerous figures and complemented with 31 plates with high-quality photographs. Despite certain outdated aspects, it remains a reference work for the Mio–Pliocene Argentine vertebrates, especially mammals. Before returning to Italy, Rovereto (1915) published a work on the longirrostrine dolphins from the Miocene of Paraná, Entre Ríos.

In summary, Argentine vertebrate paleontology, particularly in the field of mammals, rose to worldwide recognition from a humble origin with Muñiz, a strong impulse made by G. Burmeister at the *Museo Público de Buenos Aires*, the efforts of Moreno in La Plata, and then the Ameghino brothers, Florentino and Carlos. Despite some critiques, Argentine vertebrate paleontology became a globally respected field.

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ASOCIACIÓN PALEONTOLÓGICA ARGENTINA

HISTORICAL DEVELOPMENT OF INVERTEBRATE PALEONTOLOGY IN ARGENTINA: 1835–1957

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Abstract. Contributions to fossil invertebrates of Argentina began with the collections of d'Orbigny and Darwin and the publications by Forbes and Sowerby. These were continued with the collections of Stelzner and Bodenbender and the studies of Kayser, Gottsche, Behrendsen, Tornquist, and Steuer. Between 1890 and 1930, studies were conducted by foreign expeditions of Nordenskjöld, Skottsberg, and Hatcher to southern Patagonia and of Weaver to west-central Argentina, and those done from the La Plata Museum by Hauthal and Burckhardt. Studies on Triassic and Tertiary fauna began in the late 1920s. Also during this period, a series of biostratigraphic studies commenced, initially by the División de Minas, Geología e Hidrología, and later from Yacimientos Petrolíferos Fiscales. These studies were done, among others, by Groeber, Keidel, Bonarelli, Wichmann, Windhausen, Feruglio, and Piatnitzky. In 1937, with the studies of Harrington, a national paleontological school was born. Works on Paleozoic faunas by Harrington and Kobayashi, and then by Leanza and Rusconi, duplicated in *ca.* 10 years all previous production on the subject. In the 30s and 40s, Frenguelli studied insects, Upper Paleozoic continental mollusks, and siliceous microorganisms. Between 1936 and 1947, the number of titles dedicated to invertebrates doubled that of the previous decade. The subsequent period had numerous contributions by Rusconi, mainly on trilobites and graptolites. The diversity of studied invertebrates increased significantly, and studies on foraminifera began. The foundation of the Argentine Paleontological Association in 1955 and the publication of Ameghiniana from 1957 onwards, were instrumental to the continuity of researches on the matter.

Key words. Paleontology. Invertebrates. Argentina. History.

Resumen. DESARROLLO HISTORICO DE LA PALEONTOLOGIA DE INVERTEBRADOS EN LA ARGENTINA: 1835–1957. Las contribuciones al conocimiento de los invertebrados fósiles de la Argentina comenzaron con las colecciones de d'Orbigny y Darwin y las publicaciones de Forbes y Sowerby. Prosiguieron con Stelzner, Bodenbender y los estudios de Kayser, Gottsche, Behrendsen, Tornquist y Steuer. Entre 1890 y 1930 muchos estudios se debieron a las expediciones extranjeras de Nordenskjöld, Skottsberg y Hatcher a la Patagonia austral, de Weaver al centro-oeste argentino y las del Museo de la Plata por Hauthal y Burckhardt. A fines de la década de 1920 comenzaron estudios sobre insectos triásicos y terciarios. En este lapso comenzaron estudios desde la División de Minas, Geología e Hidrología, y Yacimientos Petrolíferos Fiscales. Estos estudios estuvieron vinculados a, entre otros, Groeber, Keidel, Bonarelli, Wichmann, Windhausen, Feruglio y Piatnitzky. En 1937, Harrington inició una escuela paleontológica nacional. Trabajos de faunas del Paleozoico, debidos a Harrington y Kobayashi, y luego Leanza y Rusconi llegaron en *ca.* 10 años a duplicar la producción previa sobre el tema. En los años 1930 y 1940, Frenguelli realizó estudios sobre insectos, moluscos continentales del Paleozoico superior y microorganismos silíceos. Entre 1936 y 1947 la cantidad de títulos duplicó la de la década anterior. El período subsiguiente contó con numerosas contribuciones de Rusconi referidas principalmente a trilobites y graptolites. La diversidad de phyla estudiados aumentó y se iniciaron estudios sobre foraminíferos. La fundación de la Asociación Paleontológica Argentina en 1955 y el inicio de la publicación de Ameghiniana en 1957, contribuyeron a la continuidad de las investigaciones y la publicación de sus resultados.

Palabras clave. Paleontología. Invertebrados. Argentina. Historia.

Among the earliest contributions to the knowledge of fossil invertebrates of Argentina are those resulting from the travels of Alcide D'Orbigny (1802–1857) (Fig. 1.1) and Charles R. Darwin (1809–1882) (Fig. 1.2) during the first half of the nineteenth century. D'Orbigny visited Argentina between 1826 and 1833 when he toured northeastern Argentina and the Patagonian coast along the vicinity of the Negro River mouth. The fossil invertebrates he collected in Paleogene/Neogene units were described in 1842 in one of the nine volumes of his work entitled "*Voyage dans 1'Amérique Méridionale*" published between 1835 and 1847 (d'Orbigny, 1835–1847).

Around the same time, between 1832 and 1835, Robert Fitz Roy (1805–1865) and Darwin visited different places

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in Argentina. The invertebrate fossils collected by Darwin were included in two appendices of his work "Geological Observations on the volcanic islands and parts of South America" (Darwin, 1846). One of the appendices was authored by the naturalist Edwards Forbes (1815–1854), dealing with fossils from the Cretaceous mount Tarn in the vicinity of the Strait of Magellan, nowadays Chile (Forbes, 1846). The other appendix was authored by the British naturalist George B. Sowerby (1788–1854), dealing with fossil invertebrates found in the Cenozoic of the Atlantic coast (Sowerby, 1846). They also gave rise to a short contribution on echinoderms (Desor, 1846).

Burmeister (1858) and Bravard (1858) identified invertebrates in their studies on the "Tertiary" (Neogene) of Paraná, Entre Ríos Province, Argentina, some of which were later described by Philippi (1891, 1893).

THE SCIENTIFIC STUDIES BETWEEN 1876 AND 1930

Darwin's observations on the southern Patagonian Cordillera were expanded by the German geologist Gustav Steinmann (1856–1929) (Fig. 1.3), who in 1883 visited Punta Arenas (Chile) and described the main geological features of the region located between the Strait of Magellan and Lake Argentino. The fossils he collected and those that the German geologist Rudolf Hauthal (1854–1928) collected between 1898 and 1900 while working for the Museo de La Plata were studied by Wilckens (1907a, 1907b) and Paulcke (1907).

Contributions on fossil invertebrates only began to have greater relevance at the end of the nineteenth century due to the activities of the Academia Nacional de Ciencias of Córdoba. The creation of this institution was proposed by the Director of the Museo Público de Buenos Aires Hermann Burmeister (1807–1892) and its first geologist was the German Alfred W. Stelzner (1840–1895) (Fig. 1.4).

Stelzner stayed in Argentina between 1871 and 1874 and he recognized the differences between the Sierras Pampeanas in the central region of the country from the geological units located to the west, referred respectively to as the Antecordillera or Precordillera and the Cordillera Principal, in which he recognized fossils from the Paleozoic and Jurassic. The invertebrates collected by Stelzner were studied in Germany by Emanuel Kayser (1845–1927) (Fig. 1.5) and Karl Gottsche (1855–1909). Thus, the first important contributions to the knowledge of the fossil invertebrates of the Argentine territory—after Sowerby—were made by Kayser (1876) and Gottsche (1878). These authors described the Paleozoic faunas of the Precordillera (Kayser) and the Jurassic faunas from Paso del Espinacito in the San Juan Province (Gottsche).

Stelzner was succeeded at the Academia Nacional de Ciencias of Córdoba by the Germans Ludwing Brackebusch (1849–1906) and later by Guillermo Bodenbender (1857–1941). The former elaborated the first geological map of northwestern Argentina and collected fossil invertebrates in the Paleozoic outcrops of the region, which were later studied by Kayser (1897, 1898) and by Thomas (1905). Other fossils collected by the German geologist Richard Stappenbeck (1880–1963) while working at the Dirección General de Minas, Geología e Hidrología, were studied by Clarke (1912) in the USA.

Work sponsored by the Academia Nacional de Ciencias of Córdoba resulted in a series of studies on Late Jurassic and Lower Cretaceous invertebrates from the Andes published by Behrendsen (1891, 1892), Steuer (1897), and Tornquist (1898). Such works were continued between 1907 and 1931 as a series of studies based on material sent to Steinmann or collected by himself during several trips through western South America between 1882 and 1908. Thus, after his 1902–1903 trip, fossil material from the Upper Jurassic of Cerro Lotena sent to him by the Museo Nacional de Buenos Aires led to a publication on ammonites (Haupt, 1907). Material from the Lower and Middle Jurassic sent to Steinmann by the German geologist Johann Keidel (1887–1954) were studied by Jaworski (1914, 1915, 1926), while Middle Jurassic and Oxfordian material were described by Stehn (1923). Many of these studies were published between 1893 and 1925 in a series under the title "*Beiträge zur Geologie und Paläontologie von Sudamerika*".

Of the material collected by the German paleontologist and geologist Arnold Heinrich P. Gerth (1884–1971) (Fig. 1.6), he studied the Cnidaria and ammonoids (Gerth, 1925, 1926, 1928) and the rest were included in other authors'

publications. Faunas of the Lower Jurassic were partially studied by E. Jaworski (1890–1973) and those of the Tithonian and Lower Cretaceous by Krantz (1928) and Indans (1954). Similarly, material collected by M. Récopé (?–?) during fieldwork in Neuquén Province led to a study at the School of Mines of Paris (Douvillé, 1910).

To the Academia Nacional de Ciencias also belonged the German Adolf Doering (1848–1925), who, as a member of

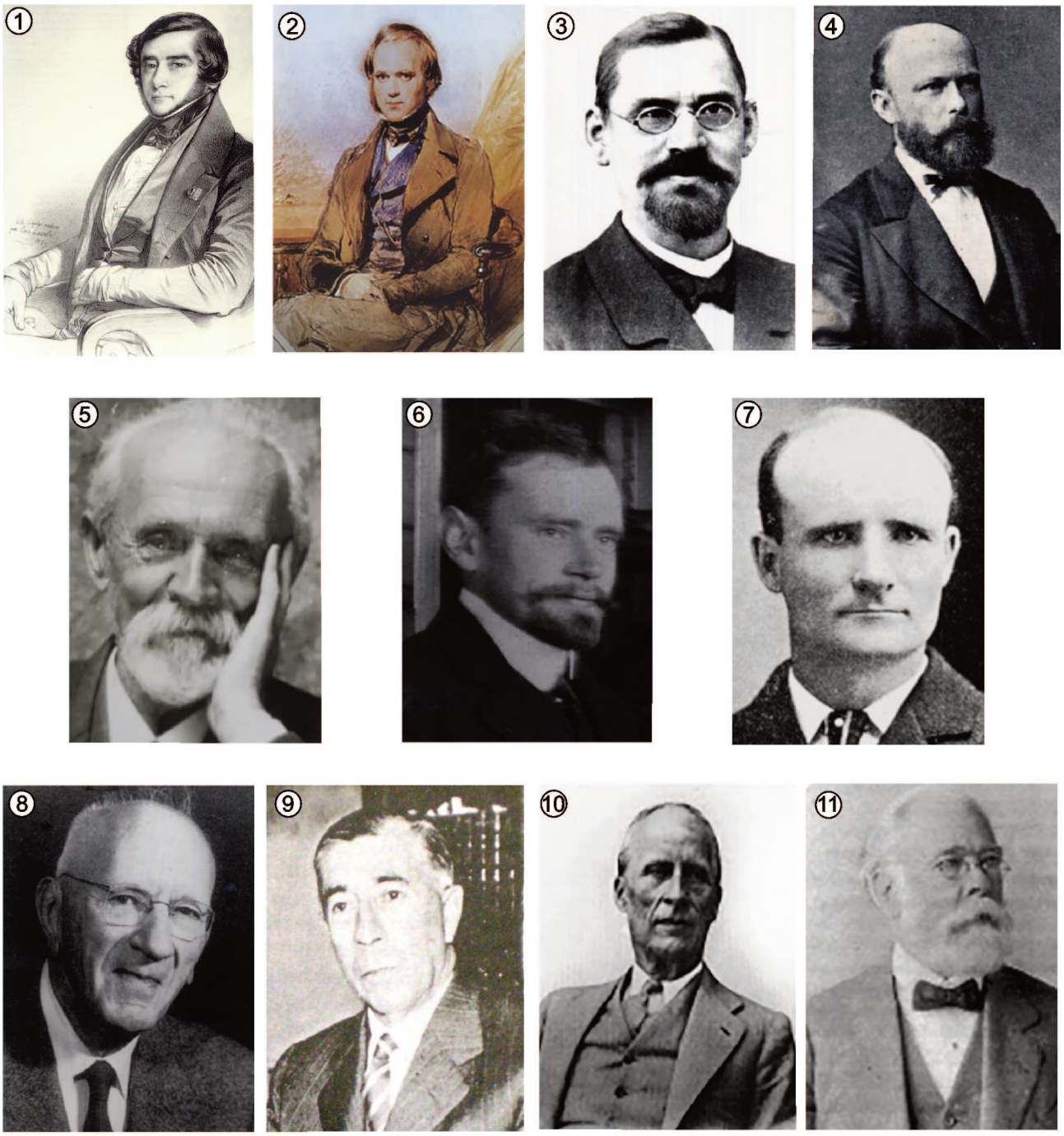

Figure 1. 1, Alcide D'Orbigny (1802–1857). **2,** Charles R. Darwin (1809–1882). **3,** Gustav Steinmann (1856–1929). **4,** Alfred W. Stelzner (1840–1895). **5,** Emanuel Kayser (1845–1927). **6,** Arnold H. P. Gerth (1884–1971). **7,** John B. Hatcher (1861–1904). **8,** Charles E. Weaver (1880–1958). **9,** Martín Doello Jurado (1884–1948). **10,** Carl J. Burckhardt (1869–1935). **11,** Hermannn von Ihering (1850–1930).

the Scientific Commission accompanied to the Argentine army commanded by Julio Argentino Roca (1843–1914) in his campaign through northern Patagonia in 1879. In the official report of that commission, Doering (1882) proposed a classification of the Cenozoic in which many invertebrates would be later located.

However, contributions to the knowledge of fossil invertebrates only acquired an almost continuous flow from 1890 onwards, following a pattern that would only be modified in the mid-1930s. During those 40 years, publications included mostly monographs that established the basic knowledge about the megafaunas of the Lower Paleozoic, Jurassic, Cretaceous, and Paleogene/Neogene of Argentina. Many of these studies—except for those originating in the Museo de La Plata and the Academia Nacional de Ciencias of Córdoba—were possible thanks to expeditions organized by foreign institutions, such as those led by the Swedish geologist Otto Nordenskjöld (1869–1928), the Swedish botanist Carl J. F. Skottsberg (1880–1963), and the American geologist and explorer John B. Hatcher (1861–1904) (Fig. 1.7) to southern Patagonia; by the American geologist Charles E. Weaver (1880–1958) (Fig. 1.8) to west central Argentina; and by the South African geologist Alexander Du Toit (1878–1948) to the Precordillera.

The most important foreign expeditions included two of Swedish origin and two from the USA. The first Swedish expedition, between 1895 and 1897, under the direction of Nordenskjöld, was carried out in Tierra del Fuego Province, although he extended his studies to the region of Ultima Esperanza and the eastern slope of the Cordillera down to 51° S. Invertebrates were studied by Steinmann & Wilckens (1908). The second expedition, under the direction of Skottsberg, was carried out between 1907 and 1909 and led to a study by Stolley (1912) on Cretaceous invertebrates.

The first USA expedition was conducted between 1896 and 1899 and was led by Hatcher from Princeton University. It resulted in an extensive geological and paleontological study, mostly in the area to the north of Lake San Martin, that was published in eight volumes under the direction of the American vertebrate paleontologist William B. Scott (1858–1947). Cretaceous invertebrates were studied by T. W. Stanton (1860–1953) and those from the Tertiary by A. E. Ortmann (1863–1927) and resulted in two important publications (Stanton, 1901; Ortmann, 1902).

The second USA expedition, between 1919 and 1926, was led by Weaver from the University of Washington and sponsored by Standard Oil of California and had an exploratory purpose linked to the search for oil. As a result, an important stratigraphic and paleontological work was published (Weaver, 1931) entitled "Paleontology and stratigraphy of the Jurassic and Cretaceous of West Central Argentina".

A special mention deserves the "Italian-Argentinian Expedition of 1881-1882", with the Italian explorer Giacomo Bove (1852–1887) as chief scientist, and the one organized by Du Toit in the 1920s. The first of these expeditions, in which the Italian geologist Domenico Lovisato (1842–1916) participated, was supported by the Instituto Geográfico Nacional and travelled along the Atlantic coast down to the Isla de los Estados and the Beagle Channel. The material collected by Lovisato, with the addition of specimens provided by the Argentine biologist and paleontologist Martín Doello Jurado (1884–1948) (Fig. 1.9), Director of the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" between 1928 and 1943, and obtained thanks to Steinmann, gave rise to the study of Richter (1925), which included the first description of microfossils from Tierra del Fuego Province.

The second expedition was led by Du Toit, who worked for different South African institutions. In the 1920s, Du Toit requested financial support from the Carnegie Institution of Washington, USA, to make observations in South America to provide evidence to support the Theory of Continental Drift of Alfred Wegener (1880–1930). The expedition lasted two months in 1923, covering Argentina's entire central region, from the Buenos Aires Province to the Cordillera. The results were analyzed in "A geological comparison of South America with Southern Africa" (Du Toit, 1927). It included an appendix in which the English paleontologist and geologist Frederick R. C. Reed (1860–1946) from the Sedgwick Museum in Cambridge, described fossils (mainly brachiopods, bryozoans, bivalves, and gastropods) from the Upper Paleozoic of the Precordillera (Reed, 1927).

The studies originated in the Museo de La Plata were associated with the Argentinean naturalist and Director of

the Museo de La Plata Francisco P. Moreno (1852–1919), Hauthal, the Swiss geologist Carl J. Burckhardt (1869–1935) (Fig. 1.10), and the Swiss paleontologist Kaspar J. Roth (1850–1924). The latter, between 1895 and 1924, was Director of the Paleontological section of the Museo de La Plata. Moreno, in addition to his own expeditions, was in charge of all the expeditions under the museum's sponsorship. They were mainly focused on the Patagonian region and resulted in collections that served as the basis for studies of Paleogene and Neogene echinoderms by Lahille (1896, 1898, 1899). Hauthal, a geologist associated with the Museo de La Plata between 1898 and 1900, studied the area between the Seno de la Ultima Esperanza, Lake Argentino, and the 47° S latitude. He drew a geological map that was published by Wilckens (1907a), who also studied Cretaceous and Cenozoic invertebrates (Wilckens, 1907b, 1921). The Late Cretaceous cephalopods collected by Hauthal and Steinmann were studied by Paulcke (1907); those from the Early Cretaceous of the Argentino and Belgrano lakes by Favre (1908); while other mollusks of the Cretaceous and Cenozoic were studied by Ihering (1897) and Wilckens (1907b). The invertebrates collected by Burckhardt and the Swiss geologist Leo Wehrli (1870–1954) in Neuquén and Mendoza provinces were studied by Burckhardt (1900a, 1900b, 1903). Roth (1899) discovered the fossiliferous levels of the Cretaceous/Paleogene boundary of General Roca. Those invertebrates were later studied by Burckhardt (1902a), Ihering (1903a), and Wilckens (1905). Roth also described the marine fauna from the Lower Jurassic of Piedra Pintada (Roth, 1902), although some invertebrates were also studied by Burckhardt (1902b). Among the geologists from the Museo de La Plata was the German Johann Valentin (1867–1897), who was the first to record the presence of ichnofossils in the lower Paleozoic of the Tandil mountains of Buenos Aires Province (Valentin, 1895). It is thus observed that the material found was generally sent to overseas institutions and that they were also studied by foreigners. Participation of German paleontologists constituted more than 40% of the total number of authors in 1890–1930 and mostly carried out studies on Mesozoic faunas, which were the only existing source of information until the mid-twentieth century.

Equally important were the contributions to the Cenozoic megafauna (Ihering, 1896, 1897, 1899a, 1899b, 1902, 1903a, 1903b, 1903c, 1904, 1905, 1907, 1914, 1922; Cossmann, 1899; Doello Jurado, 1915, 1919, 1922, 1927). In these studies, the German-Brazilian Hermann von Ihering (1850–1930) played a fundamental role in 1896–1922 (Fig.1.11). Ihering settled in Brazil in 1880. After 1910, Doello Jurado was instrumental in these contributions. Ihering complemented the studies on fossil vertebrates undertaken by brothers Carlos and Florentino Ameghino from the Museo Nacional de Buenos Aires (since 1957, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia").

Knowledge on Meso–Cenozoic invertebrates—mostly mollusks, brachiopods, corals, echinoderms, and bryozoans—was expanded from the 1920s onwards. A series of studies on Triassic and Tertiary insects from the west and north of the country appeared, due mostly to Argentine or foreign authors residing in the country (Cabrera, 1928; Schlagintweit, 1936; Frenguelli, 1938a, 1938b, 1939; Viana & Haedo Rossi, 1957). It is worth noting the contributions by Dallas (1924) and Cockerell (1925, 1926a, 1926b, 1936). All these studies were later synthesized by Fossa Mancini (1941). In parallel, research conducted at the Museo de La Plata would lead to specific publications on Cenozoic echinoderms (Sáez, 1930) and Paleozoic nautiloids (Sáez, 1931).

Thus, between 1890 and 1920, almost half of the publications on fossil invertebrates were related to Cenozoic mollusks and between 1890 and 1936 was published a large proportion of all works on Cenozoic invertebrates known until the mid-twentieth century. Among them are studies of Bryozoa (Canu, 1904, 1909, 1911), Porifera (Principi, 1915), Cnidaria (De Angelis D'Ossat, 1908), Gastropoda (Borchert, 1901), and Echinodermata (Lahille, 1896, 1898; Lambert, 1903; Ruedemann, 1916) from the Paleozoic, Mesozoic, and Cenozoic of Patagonia. Most of them are still nowadays fundamental contributions on these subjects. Except those of Lahille and Lambert, all studies were conducted abroad with specimens that were sent from Argentina.

Between 1876 and 1935, only 30% of the publications were edited in the country and approximately 75% of these

were published equally by the Museo Argentino de Ciencias Naturales, the Museo de La Plata, and the Academia Nacional de Ciencias of Córdoba. Those of the latter included useful Spanish versions of a series of classic monographs originally published in other languages. Also during this period, a series of biostratigraphic studies were carried out by the División de Minas, Geología e Hidrología of the Ministerio de Agricultura and from Yacimientos Petrolíferos Fiscales (state oil company). These biostratigraphic studies were conducted, among others, by the German geologists Paul F. K. Groeber (1885–1964), Anselm Windhausen (1882–1932), Richard Wichmann (1881–1930), Gerth, Keidel, and Stappenbeck and the Italian paleontologist Cayetano Rovereto (1870–1952) and geologists Guido Bonarelli (1871–1951) (Fig. 2.1) Egidio Feruglio (1897–1954) (Fig. 2.2), Alejandro Matveievich Piatnitzky (1879–1959), and Remigio Rigal (1894–1990). Many of these contributions, even if not exclusively on paleontology, came to bear later a decisive influence on its development. The fossil invertebrates they collected were studied abroad, either by themselves (*e.g.*, Bonarelli, Gerth, Feruglio, Piatnitzky) or by specialists from institutions to which they were affiliated.

Bonarelli, together with the Argentinean geologist Juan J. Nájera (1887–1966), published in 1921 an important study on the Cretaceous stratigraphy and paleontology from the Lake San Martin region. This study was later extended by Feruglio (1934a, 1934b, 1936) on Mesozoic and Cenozoic fossil invertebrates of different localities of Patagonia and by Piatnitzky (1938) on those of the region of Cardiel and San Martin lakes. Bonarelli (1921, 1927) also covered in his contributions invertebrates from units recognized in northern Argentina.

Piatnitzky discovered in the 1940s a series of levels with Upper Paleozoic invertebrates in the central and western area of Chubut Province, which would give rise to important collections by the Argentinean geologist Tomas Suero (1915–1963) and laid the basis, from the 1960s onwards, of important studies by researchers of the Museo de La Plata directed by Arturo J. Amos (1927–1999). Rovereto, on the other hand, collected bryozoans from the Paleogene/Neogene of Peninsula Valdes, which were studied in Italy by Conti (1949). A specific exception was Rigal, who, in December 1924, collected Lower Jurassic ammonites in the Cordillera del Espinacito, south of San Juan Province that were described shortly after (Rigal, 1930).

THE FIRST INVERTEBRATE ARGENTINE PALEONTOLOGISTS, 1937–1947

The second half of the 1930s and the following decade changed the development of Argentine fossil invertebrates studies. During those years, contributions by paleontologists based overseas were reduced and those made by Argentinean paleontologists began to prevail. This was mainly related to foreign researchers residing in the country, together with a small group of paleontologists born in Argentina. Hence, the first Argentinean group of invertebrate paleontologists arose. Despite their ups and downs, they showed a remarkable continuity over the following decades.

Apart from the contributions mentioned above by Doello Jurado (1915, 1919, 1922, 1927), the beginning of this new era of Invertebrate Paleontology in Argentina can be traced back to 1937, the year in which the first work on fossil invertebrates published by Horacio J. Harrington (1910–1973) appeared (Fig. 2.3). Not only was Harrington a pioneer of a national paleontological school, but with him, diverse studies initiated and their importance would be appreciated in the following decades. Harrington (1937) study on Ordovician fossils—perhaps because of the influence of Keidel—revitalized Kayser's research on Paleozoic invertebrates from the end of the nineteenth century, which except for some isolated contributions had languished until then.

Harrington's publications dealing with Paleozoic invertebrates (mainly trilobites and graptolites) from Argentina, with contributions from Japanese geologist Teiichi Kobayashi (1901–1996) (Fig. 2.4), Armando F. Leanza (1919–1975) (Fig. 2.5), and Carlos Rusconi (1898–1969) (Fig. 2.6), doubled all previous publications on the subject in approximately 15 years (*i.e.*, Harrington, 1937, 1938; Kobayashi, 1935, 1936, 1937a, 1937b; Leanza, 1941; Harrington & Leanza, 1942, 1943, 1952, 1957; Rusconi, 1946a, 1946b, 1948a, 1949b, 1950a, 1950b, 1951, 1952a, 1952b, 1953, 1954a, 1954b, 1955a, 1955b; Borrello & Gareca, 1951). Thus, not only was the knowledge of Lower Paleozoic faunas increased but also that of the Upper Paleozoic, which had been initiated by Reed (1927).

At the same time, contributions on Cenozoic mollusks from Mesopotamia and the Buenos Aires Province were published. The beginning of the 1930s had a fundamental protagonist: Joaquín Frenguelli (1883–1958) (Fig. 2.7). Although his contributions to the field of fossil invertebrates were few in comparison with those he made in other fields of the natural sciences, they were the only regional studies on Cenozoic insects (Frenguelli, 1938a, 1938b, 1939), Upper Paleozoic and Triassic continental mollusks (Frenguelli, 1945), and different types of siliceous microorganisms. But Frenguelli's decisive influence on the study of invertebrates began with him as Director of the Museo de La Plata and Head of the División de Paleozoología Invertebrados y Paleobotánica of the same institution. Under his direction, the Museo de La Plata acquired a renewed relevance, evidenced in the quantity and quality of the publications produced until almost the end of the 1940s. As a researcher, Frenguelli promoted numerous biostratigraphic studies, especially about the Mesozoic of Neuquén Province, which enriched the museum's well-organized collections. It was then that Harrington and the Italian geologist Enrico Fossa Mancini (1884–1950) also participated, where researchers such as A. Herrero Ducloux (1915–1965), Suero, Angel V. Borrello (1919–1971) (Fig. 2.8), and Leanza, among others, were formed, who in their works would also show the influences of Keidel and Groeber. It is worth mentioning the studies of Fossa Mancini (1938) on bivalves from the Cretaceous/Paleogene boundary; of Leanza (1940a, 1940b, 1942, 1943, 1944, 1945a, 1946, 1947, 1949) and Herrero Ducloux & Leanza (1943) on bivalves and, especially, ammonites from the Mesozoic. They were followed by the contributions from Carral Tolosa (1942b), Lambert (1944), Sokolov (1946), and Stipanicic (1951).

Between 1936 and 1947, the number of publications dedicated to fossil invertebrates doubled that of the previous decade and comprised half of all the publications until then. Of the 80% of fossils in Argentina published,

Figure 2. 1, Guido Bonarelli (1871–1951). **2,** Egidio Feruglio (1897–1954). **3,** Horacio J. Harrington (1910–1973). **4,** Teiichi Kobayashi (1901–1996). **5,** Armando F. Leanza (1919–1975). **6,** Carlos Rusconi (1898–1969). **7,** Joaquín Frenguelli (1883–1958). **8,** Ángel V. Borrello (1918–1971).

about 60% were known through the publications of the Museo de La Plata under the direction of Frenguelli. During that period, 90% of the authors resided in the country and important papers on the Paleozoic, Mesozoic, and Cenozoic faunas were published. For example, contributions of Parodiz (1944, 1946a, 1946b, 1948, 1949, 1951, 1962) and Carral Tolosa (1937, 1939, 1942a) dedicated mostly to Quaternary mollusks from Buenos Aires Province.

When Frenguelli left the Museo de La Plata, there was an abrupt end of that institution as an important center for the study of fossil invertebrates in the country. It would be almost 20 years before it regained some extent in the matter due to the presence of new researchers, although not equally important in its publications.

TOWARDS THE ARGENTINE PALEONTOLOGICAL ASSOCIATION AND AMEGHINIANA, 1947–1957

The following period, which extends from 1947 until the foundation of the Asociación Paleontológica Argentina and the subsequent appearance of the journal Ameghiniana in 1957, would show a 20% decrease in the total number of publications compared to the previous decade. An exception to this trend are the numerous contributions made by Rusconi, mostly in the Revista del Museo de Historia Natural of Mendoza, and referred mainly to Lower Paleozoic trilobites and graptolites. It is worth mentioning here the contributions by Cecioni (1953) to the knowledge of the Lower Paleozoic nautiloids. The total number of publications increased by 30% and although they focused on the study of the Lower Paleozoic faunas, equally proportional publications centered around Mesozoic and Cenozoic invertebrates.

Especially notable in this period was the diversity of studied phyla, reaching proportions never seen before. The articles included works on Tertiary gastropods (Camacho, 1953) and echinoderms (Bernasconi, 1954, 1959) and on Cretaceous invertebrates from Tierra del Fuego Province (Camacho, 1949; Furque & Camacho, 1949). Among these studies, it is worth mentioning those referring to foraminifera, which marked the beginning of a new era in the study of the Late Cretaceous and Tertiary invertebrates (Camacho, 1954; Boltovskoy, 1961; Bertels, 1964). The emphasis shifted from the mega to the microfauna. The first courses of micropaleontology taught in the country by the Argentinean paleontologist Horacio H. Camacho (1922–2015) (Fig. 3.1) also contributed, as they were taken by most of the main Argentinean paleontologists during the second half of the twentieth century.

Besides the publications by the Museo de Historia Natural of Mendoza, about 35% of the remaining publications were edited abroad, following in quantity to those published by the Sociedad Argentina de Geología (founded in 1945). Although the number of Argentine authors doubled, most of them would not be actively participating in the study of fossil invertebrates. Added to the partial decrease in the total number of contributions, their dispersion in different publication media, the departure of several important researchers and an increase in foreign researchers, a growth crisis was evident.

The foundation of the Asociación Paleontológica Argentina in 1955 and the publication of its journal Ameghiniana from 1957 onwards were transcendent milestones in the history of the study of fossil invertebrates in the country. This auspicious event practically coincided with the creation of the Consejo Nacional de Investigaciones Científicas y Técnicas and of the Comisión Científica de la Provincia de Buenos Aires, organizations that would contribute to the continuity of scientific research and the publication of its results. Thus, the pursuit of common goals and with the support of two institutions created specifically to support scientific research, paleontologists and Argentine paleontology began, during the second half of the 1950s, a

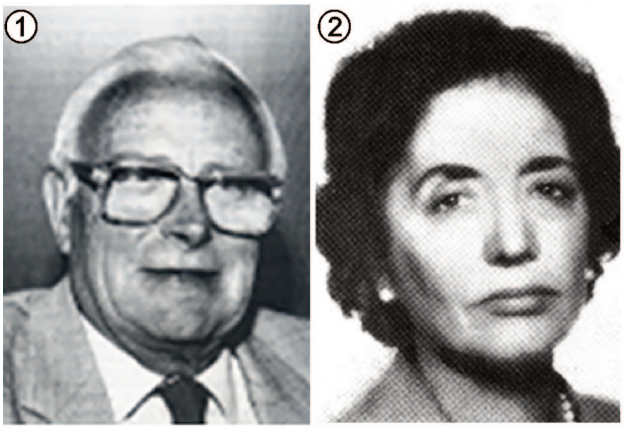

Figure 3. 1, Horacio H. Camacho (1922–2015). **2,** Hildebranda Á. Castellaro (1913–1995).

trend of sustained progress that would continue in the following decades.

Notable events of this period were also the publication, in the 1960s, of the Paleontographia Bonaerense by the initiative of Borrello and with the support of the Comisión Científica de la Provincia de Buenos Aires; the initial volumes of the Guia Paleontológica Argentina with the support of the Consejo Nacional de Investigaciones Científicas y Técnicas; and the first Congresos Paleontológicos Argentinos under the auspice of the Asociación Paleontológica Argentina. Only the Guias Argentinas del Paleozoico were published. The Argentinean Hildebranda Á. Castellaro (1913–1995) (Fig. 3.2) was the main author of the Cambrian–Ordovician (Castellaro, 1963) and the Silurian–Devonian (Castellaro, 1966) periods, in which she synthesized the existing knowledge. The Guia Paleontológica Argentina and the Paleontographia Bonaerense included issues/volumes on fossil invertebrates. They responded to the need for an updated synthesis of the knowledge obtained over more than 100 years of research and, until then, scattered in different publications, often difficult to access. Following this goal but in a wider field, Camacho published in 1966 the book "*Invertebrados Fósiles*", the first of its kind produced in the country (Camacho, 1966).

Finally, it should be noted that the study of Argentine fossil invertebrates was led by foreigners at the end of the nineteenth century and the beginning of the twentieth, mainly focussing on the publication of the faunas and their affinities, in addition to documenting their existence. At later stages, the interest of Argentinean paleontologists focus shifted to stratigraphic applications. The emphasis on the stratigraphic aspects of paleontology is probably derived from economic applications and the geological background of almost all Argentine invertebrate paleontologists. This was clearly evidenced by the fact that nearly all groups that supposedly had no stratigraphic importance were studied by foreign specialists or Argentine biologists in isolated publications, or they were even totally ignored. In many cases, such an approach to paleontological research also led to scarce attention to the basic morphological features and precluded studying poorly known faunas.

Finally, paleoecological, paleobiogeographic, and evolutionary studies were also marginalized, which are the natural corollary of morphological and taxonomical studies and the necessary basis for any well-founded correlation. It is a fact, however, that invertebrates' paleontology in Argentina during this period was affected by the lack of relationship between the number of active paleontologists and the questions to be solved. It is worth mentioning that micropaleontology started and developed about 30 years later than in other countries.

CONTRIBUTIONS TO THE KNOWLEDGE OF DIFFERENT GROUPS OF FOSSIL INVERTEBRATES

Foraminiferida

Leaving aside the studies of Pleistocene and Holocene faunas mainly by Boltovskoy (1961), the first studies of fossil foraminifera were carried out by Camacho in the late 1940s and early 1950s, focused on material from the Late Cretaceous (Camacho, 1954). These studies would be continued in the 1960s by Bertels (1964), among others, focusing on benthic and planktonic foraminifera of the Cretaceous–Paleogene and Paleogene–Neogene of Patagonia.

Radiolaria

Richter's (1925) study on Cretaceous material from Isla de los Estados is the only study of radiolarians in this period.

Porifera

Fossil Porifera in Argentina were scarcely studied. Demospongea from the Ordovician and Cenozoic of Patagonia and the Quaternary of Buenos Aires Province were published by Kayser (1876) and Principi (1915), respectively. The presence of dubious Hexactinellida in the Middle Cambrian of Mendoza Province was recorded by Rusconi (1952a, 1954a).

Bryozoa

Bryozoa in Argentina was documented with the discovery of Trepostomata in the Devonian Precordillera by Kayser (1876) and Cyclostomata and Cheilostomata from the Tertiary of Patagonia by Ortmann (1902) and, fundamentally, in the classic contributions made by Canu (1904, 1911). Subsequently, Conti (1949) made only one more contribution of Bryozoans from the Tertiary of Chubut during this time interval.

Cnidaria

The knowledge of the Cnidaria of Argentina was based on the study of some Conulata and Tabulata from the Silurian and, fundamentally, from the Devonian by Thomas (1905), Gerth (1926, 1928), and Weaver (1931), and on the study of Scleractinia from the Lower–Middle Jurassic and Lower Cretaceous of the Neuquén Basin.

Brachiopoda

The study of brachiopods in Argentina was based on the contributions from Kayser (1897), Thomas (1905), and Clarke (1912) from the Lower and Mid–Paleozoic of western and northern Argentina, to which those of Harrington (1938) and Leanza (1945b, 1948) would be added. The monograph by Behrendsen (1892) on the Mesozoic faunas of western Argentina included a few Jurassic brachiopods as well.

Also from the first half of the twentieth century were the studies of Jaworski (1926), Feruglio (1936), and Weaver (1931) on Jurassic and Cretaceous faunas and those of Ihering (1903b) and Doello Jurado (1922) on Tertiary faunas, all of them including brachiopods from Patagonia.

During the second half of the 1950s, a new era began with the publications of Castellaro (1959) and Amos (1958a, 1958b) on brachiopods from the Silurian of the Precordillera and the Upper Paleozoic of San Juan and Chubut provinces, respectively.

Mollusca

The Phylum Mollusca was one of the most studied and publications throughout this period represented approximately 46% of Argentina's total articles published dedicated to fossil invertebrates. The groups that received the most attention were, in decreasing order, Gastropoda (49%), Cephalopoda (34%), and Bivalvia (17%).

There were no studies on Polyplacophora, a class that extends from the Cambrian to the present. Likewise, Scaphopoda, recorded worldwide from the Ordovician to the Holocene, were barely mentioned by Wilckens (1907b) based on some specimens from the Late Cretaceous of southern Patagonia.

The Hyolitha—either considered as a Class within Mollusca or as an independent Phylum—constitute a group restricted to the Paleozoic, whose presence in Argentina was not recorded in the period. Similarly, the Tentaculitoidea, known from the Ordovician to the Devonian, remained virtually ignored in Argentinean studies on Paleozoic invertebrates.

Gastropoda. The Gastropoda group of Mollusca was the subject of numerous publications. Gastropod material was described mostly in monographic works during the last part of the nineteenth century and first half of the twentieth century. For example, Gottsche (1878), Behrendsen (1891, 1892), Haupt (1907), Jaworski (1926), Carral Tolosa (1942b) for the Jurassic of western Argentina and Patagonia, Stanton (1901), Paulcke (1903), Wilckens (1907b), Bonarelli (1921, 1927, 1945), Weaver (1931), Feruglio (1934a, 1934b, 1936) for the Cretaceous of Patagonia and north of the country, Sowerby (1846), Borchert (1901), Ortmann (1902), Ihering (1907), and Camacho (1949, 1953) for the Tertiary of Patagonia and Mesopotamia. The studies by Parodiz (1944, 1946a, 1946b, 1949, 1951) deserve a special mention here. Older Gastropoda were published by Kayser (1876) for the Ordovician and by Reed (1927) for the Upper Paleozoic.

Bivalvia. The Bivalvia were the mollusks that had the lowest number of publications in the period, representing 17% of the total. The material of bivalves was described, mostly in some of the monographic works mentioned above in the section corresponding to the Gastropoda, and referred mainly to the Jurassic of western Argentina (Behrendsen, 1892; Jaworski, 1915; Groeber, 1924) and the Cretaceous (Forbes, 1846) and Tertiary (Ihering, 1902; Ortmann, 1902) from Patagonia. The works on faunas of the Upper Paleozoic and Triassic (Frenguelli, 1945), Upper Cretaceous, and Tertiary (Fossa Mancini, 1938) are from the second half of this period. Lower Jurassic Bivalvia were studied from western Chubut by Feruglio (1934b) and Carral Tolosa (1942b), from Piedra Pintada, Neuquén by Leanza (Leanza, 1940a, 1940b, 1942). Mesozoic trigonids from Neuquén were described by Lambert (1944). Ordovician bivalves from northern Argentina were also studied by Harrington (1938).

By the end of the 1950s, studies on bivalves were restricted to specific descriptions of material from the Tertiary of Patagonia (Camacho & Fernández, 1956; Camacho, 1957), except for the description, by Harrington (1955), of the *Eurydesma* fauna of the Upper Paleozoic of the Sierras Australes.

Cephalopoda. The Cephalopoda constitute, after the Gastropoda, the mollusks that have been the subject of the largest number of publications in the period considered, representing 34% of the total number of publications referring to Mollusca. More than 90% of these publications were dedicated to Jurassic and Cretaceous ammonoids.

Like Bivalvia, this trend gave continuity to a situation observed from the very beginning of the studies of fossil invertebrates in the country. Between the late nineteenth and early twentieth centuries, foreign researchers made a series of contributions, mostly monographic, on ammonoids. Authors of these studies were Behrendsen (1891, 1892), Steuer (1897), Tornquist (1898), Burckhardt (1900a, 1900b, 1903), Haupt (1907), Douville (1910), Jaworski (1914, 1915), Stehn (1923), Gerth (1925), Krantz (1928), and Weaver (1931) for the Jurassic and Cretaceous of west-central Argentina. The ammonoids from the Mesozoic, mainly Cretaceous, of the southern region of the country were studied by Stanton (1901), Paulcke (1907), Favre (1908), Stolley (1912), Bonarelli & Nágera (1921), Feruglio (1936), and Piatnitzky (1938).

In the 1940s, the studies of the first Argentine ammonitologist A. F. Leanza began. He studied ammonites from the Upper Jurassic and Lower Cretaceous of the Neuquén Basin (Leanza, 1944, 1945a, 1946, 1947, 1949, 1958; Leanza & Giovine, 1949) and in the following decade he would focus mainly on the Cretaceous of the Austral Basin. Marginally, there were some specific publications by other Argentinian authors on *aptychi* (Rusconi, 1948b) and ammonites from the Lower Cretaceous of the Neuquén Basin (Giovine, 1950, 1952), as well as studies from some foreign authors (Maubeuge & Lambert, 1955) on Middle Jurassic faunas.

The studies on Mesozoic Nautiloidea were included in several monographs dedicated to the ammonoids (see above) and those on Cenozoic nautiloids in a paper by Ihering (1922). Knowledge of lower Paleozoic nautiloids was based on a specific contribution by Rusconi (1951) and on one study by Cecioni (1953) on specimens from northern Argentina.

Annelida

Contributions to the knowledge of the Annelida of Argentina were based on a few records from the marine Lower Jurassic of Mendoza Province (Behrendsen, 1892) and from the marine Lower Cretaceous of Patagonia (Weaver, 1931; Camacho, 1949).

Arthropoda

As already noted, contributions to Arthropoda knowledge accounted for 22% of the total contributions made on fossil invertebrates, most of them belonging to trilobites.

Trilobita. Kayser (1876, 1897, 1898) studies of the Ordovician faunas conducted in the late nineteenth century were followed, during the 1930s, by those of Kobayashi (1935, 1936, 1937a, 1937b). Only Thomas (1905) and Clarke (1912) contributions to Devonian faunas were known in the early twentieth century.

The situation changed in the 1930s, when a series of contributions were published based on the Ordovician record from the north of the country. These were started by Harrington in 1937 and continued partly in collaboration with Leanza (Leanza, 1941; Harrington & Leanza, 1942, 1943, 1957), culminating in the 1950s with the important work "Ordovician Trilobites of Argentina" (Harrington & Leanza, 1957). During the late 1940s and 1950s, several contributions were also made by Rusconi (1946a, 1950b, 1952a, 1952b, 1955a, 1955b).

Crustacea. In the case of fossil Crustacea, specific references to representatives of the Class Cirripedia were found in Ortmann (1902) and Feruglio (1949, 1950) for the Tertiary of Patagonia. The presence of Ostracoda was documented during the Paleozoic (Thomas, 1905). Conchostraca was fundamentally restricted to the Cenozoic (Rusconi, 1946a, 1946b, 1947, 1948c, 1948d, 1948e) and only a few Decapoda were recorded in the Jurassic of Mendoza Province (Rusconi, 1948a) and the Late Cretaceous and Cenozoic of Patagonia (Wilckens, 1907b, 1921).

Insecta. Main studies on Insecta were carried out in the 1920s and 1930s by Cabrera (1928) and Wieland (1926) on material from the Triassic of Mendoza Province and, fundamentally, by Cockerell (1925, 1926a, 1926b, 1936) and Schlagintweit (1936) on representatives from the Paleocene of the northwest of the country. Viana & Haedo Rossi (1957) studied formicides from the Miocene of Santa Cruz Province. Other records included fossil nests from the Tertiary of Patagonia, mainly described by Frenguelli (1938a, 1938b, 1939).

Echinodermata

Fossil Echinodermata from Argentina were inadequately studied. The first contribution was made by Desor (1846) in the mid-nineteenth century, referring to Echinoidea from the Tertiary of Patagonia. Afterwards, only specific contributions were produced (Lahille, 1896, 1898; Ortmann, 1902; Lambert, 1903), with a few additions from the Devonian (Ruedemann, 1916) and the Mesozoic of Neuquén Province (Weaver, 1931; Frenguelli, 1944) and Southern Patagonia (Wilckens, 1907b; Melinossi, 1935). Finally, in the late 1950s, Bernasconi (1954, 1959) published a revision of the Echinoidea from the Late Cretaceous and Tertiary, based on the existing collections in the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia".

Graptolithina

Except for some isolated references dating back to the late nineteenth century (Kayser, 1876) and those produced in 1949–1950 describing Ordovician material from the north and west of the country (Rusconi, 1949a, 1949b, 1949c, 1949d, 1949e, 1950c; Borrello & Gareca, 1951), contributions to the study of graptolithina had to wait until 1960, the year in which J. C. M. Turner's work entitled "Graptolithic faunas of South America" was published (Turner, 1960).This was an important contribution to the knowledge of Graptoloidea and Dendroidea, mainly from the Ordovician of western and northern Argentina.

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ASOCIACIÓN PALEONTOLÓGICA ARGENTINA

THE FORMATION PROCESS OF THE AMEGHINO'S ARCHAEOLOGICAL COLLECTION PRESENTED IN PARIS IN 1878: COMPOSITION, CATALOGING, AND DESTINATION

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Abstract. In this study, we analyze the formation process of the collection that Florentino Ameghino presented to the occidental world at the Universal Exposition, which took place in Paris in 1878 and from which he materially supported his theory regarding the antiquity of "men" in the Río de La Plata Basin. We develop an analysis based on the same structure of the "*Catalogue spécial de la section Anhtropologique et Paléontologique de la République Argentine a L'expositionuniverselle de Paris (1878)*" and we contrast it with the information provided in his previous works. In this Special Catalog, Ameghino provided information on human, faunal, and cultural remains, which contributed to the construction of his collection up until before the exhibition. The structuring of the Special Catalog connects us with the evolution of Ameghino's scientific thought through his classification regarding the natural or anthropic origin of the objects, the temporal order that he assigned to the findings, and the sedimentary deposits carrying the objects. We analyze the classificatory categories, their implications, and the curatorial destinations of the collection that Ameghino presented in Paris. The analysis of this collection, which nowadays constitutes one of the most important regarding the knowledge of the antiquity of the human population in South America and its relationship with the fossil mammals of the Pleistocene–Holocene, is limited by the dissociation of the cultural and biological evidence that was found in the same context and that is currently housed in different national and foreign institutions.

Key words. Natural object. Cultural object. Quaternary. Miocene. Buenos Aires.

Resumen. EL PROCESO DE FORMACIÓN DE LA COLECCIÓN ARQUEOLÓGICA DE AMEGHINO PRESENTADA EN PARIS EN 1878: SU COMPOSICIÓN, CATALOGACIÓN Y DESTINO. En este estudio analizamos el proceso de formación de la colección que Florentino Ameghino dio a conocer al mundo occidental en la Exposición Universal de París en 1878, a partir de la cual sustentó con materialidad, su teoría respecto a la antigüedad del "hombre" en la cuenca del Río de La Plata. El análisis lo desarrollamos a través de la estructuración que presenta el *"Catalogue spécial de la section Anhtropologique et Paléontologique de la République Argentine a L'exposition universelle de Paris (1878)"* y lo contrastamos con la información volcada en sus obras precedentes. En este Catálogo Especial, Ameghino brindó información de restos humanos, faunísticos y culturales, entre otros, que conformaban su colección hasta antes de la exposición. La estructuración del Catálogo Especial nos conecta con la evolución del pensamiento científico de Ameghino a través de su clasificación respecto al origen natural o antrópico de los objetos y del orden temporal que le asignó a los hallazgos y a los depósitos sedimentarios portadores de los objetos. Nosotros analizamos las categorías clasificatorias, las implicancias de esta, y los destinos curatoriales de la colección que Ameghino presentó en París. El análisis de esta colección, que es una de las más importante respecto al conocimiento de la antigüedad del poblamiento humano de América del Sur y su relación con los mamíferos fósiles del Pleistoceno–Holoceno, tiene como limitante la disociación de las evidencias culturales y biológicas que fueron halladas en un mismo contexto y que están alojadas en diferentes instituciones nacionales y extranjeras.

Palabras clave. Objeto cultural. Objeto natural. Cuaternario. Mioceno. Buenos Aires.

THE SURVEY, classification, quantification, and education about a country's natural and cultural resources are foundational acts of the museological institutions of the 19th century in Argentina (Podgorny & Lopes, 2008). The first three foundational acts have a documentary record in the catalogs that account for the characters that define "things" that constitute the collections that are preserved, studied, and exhibited in the museums. In the catalogs,

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"things" become objects that identify evolutionary processes, availability, and variability of resources in the different inter and extra-planetary areas, as well as the acquisition and transmission of knowledge for the generation and reproduction of uses and customs in human societies. Another dimension of analysis includes the conformation of the catalogs as information records, where the classificatory paradigms and the scientific knowledge represented in the prominence of the objects in a determined temporal context are reflected.

In the development of archeology and paleontology of the Río de La Plata Basin, the "*Catalogue spécial de la section Anhtropologique et Paléontologique de la République Argentine a L'exposition universelle de Paris (1878)*" (from now on cited as Special Catalog), written by Florentino Ameghino (1853–1911) based on his collection of bioanthropological remains, cultural materials, fossils from the Pampean region and geological samples, is the one that has had the greatest international impact since the 19th century. This international impact originates from Ameghino's participation in the Universal Exposition in Paris, held from May 1st to November 10th, 1878. In this exhibition of science, art, and technology and at the stand of Argentina, various archaeological, paleontological, and geological objects from the Ameghino collection and other persons were exhibited (Fig. 1). Complementarily, albums of photographs and drawings of some of the objects from the collection of the Museo Antropológico y Arqueológico de Buenos Aires were also presented. Due to the absence of several owners of some objects and the poor conditions in which they arrived to France, Ameghino asked the Argentine authorities for permission to restore the affected objects and to create a catalog with all of them. The request was accepted and thus, the Special Catalog was created, which ended up accompanying the exhibition.

In the Special Catalog, each collection was identified in

Figure 1. Pavilion of the Argentine Republic, Universal Exhibition in Paris, 1878. General view of the collections of the Anthropology and Paleontology section. Museo de La Plata, Historical and Photographic Archive **EUP-001-001-002**.

independent sections, recording its owner's identity, the selected sample's origin, and the identifying number for each object or lot of objects. In this sense, the Special Catalog allows the composition of each collection to be independently analyzed.

A comprehensive analysis of Ameghino's work allows us to recognize the story behind the preparation of the Special Catalog. The collection of objects taken by him to France had been previously cataloged and included in his study "*El hombre cuaternario en la Pampa*" presented at the Sociedad Científica Argentina in 1876, which remained unpublished until 1914 when it was included in Volume 2 of the "*Obras Completas y Correspondencia Científica de Florentino Ameghino*" published by Alfredo Torcelli (1864–1936).

For this study, we will analyze the distribution and sequence with which Ameghino incorporated his private collection of archaeological and paleontological objects into the Special Catalog. The development of this analysis will allow us to evaluate diverse aspects concerning the formation process of its collection, the evolution of its temporal paradigm concerning the prehistory of the Río de La Plata Basin, its classificatory schemes, its position about the nature of things, and how its distinction between natural and cultural objects affected the life history of the evidence that was selected and that is still called for today by research referring to the antiquity and characteristics of the process of human settlement in southern South America (*e.g.,* Bonomo, 2002; Politis & Bonomo, 2011; Toledo, 2011, 2016, 2021; Lanzellotti & Acuña, 2014; Politis, 2014; Bonomo & Scabuzzo, 2016; Politis *et al.*, 2019; Acosta *et al.*, 2020; Simón *et al.*, 2023).

MATERIALS AND METHODS

In our study, we analyze the "*Catalogue spécial de la section Anhtropologique et Paléontologique de la République Argentine a L'exposition universelle de Paris (1878)*" reproduced in Volume 2 of the "*Obras completas y correspondencia científica de Florentino Ameghino*" (Ameghino, 1878 in Torcelli, 1914). In addition, we analyze the manuscripts presented at the Sociedad Científica Argentina in 1876 entitled "*El hombre cuaternario en la Pampa*" and "*Ensayos de un estudio de los terrenos de transporte cuaternarios de la provincia Buenos Aires*", which remained unpublished until 1914, when it was included in the aforementioned Volume 2.

The taxonomic nomenclature used in this work is the same as cited in the original works and catalogs.

THE CATALOG OF THE "*EL HOMBRE CUATERNARIO EN LA PAMPA*" FROM 1876

The main objective of the list or catalog of archaeological and paleontological pieces that Ameghino incorporated in his study "*El hombre cuaternario de la Pampa*" was to support his assertions about the coexistence of paleofauna and "men" in the Río de La Plata Basin. This catalog was constituted by 117 entries that accounted for the same number of objects that supported the evidence of his postulate (see Supplementary Information 1). Numbers 1 to 19 correspond to human skeletal remains found in the Arroyo Frías (Fig. 2), number 82 to an exoskeleton fragment assigned to *Glyptodon*, and the remaining numbers to lithic objects, burned earths ("*tierras cocidas*"), and fragments of bones and teeth that, according to Ameghino (1876a, p. 36–38 in Torcelli, 1914), presented evidence of anthropic activity. Except for human remains and the exoskeleton of *Glyptodon* that were recognized as coming from Arroyo Frías, the rest of the specimens present undetailed references such as "*cerca de* [nearby] Luján", "Mercedes" or "San Antonio de Areco" (Fig. 2) and in some cases did not present any geographical reference at all.

CATALOGUE SPÉCIAL DE LA SECTION ANHTROPOLOGIQUE ET PALÉONTOLOGIQUE DE LA RÉPUBLIQUE ARGENTINE A L'EXPOSITION UNIVERSELLE DE PARIS DE 1878

The Special Catalog consists of around 8,000 pieces and is divided into two main sections entitled Anthropology and Paleontology. The first is subdivided into six subsections, of which the first is identified as the Paleolithic Period (Fig. 3). The list of this subsection is headed with the number 1031 (see Supplementary Information 1; see below) which is the number by which Ameghino identifies the human skeletal remains that he recovered on the left bank of the Arroyo Frías (Fig. 2) and that he assigned as coming from his identified "*Paradero humano Paleolítico número 1*" (Parad. h.p.n.1). Within the catalog, it is mentioned that these human remains were found associated with faunal remains, charcoal, carved lithic material, and fragments of burned

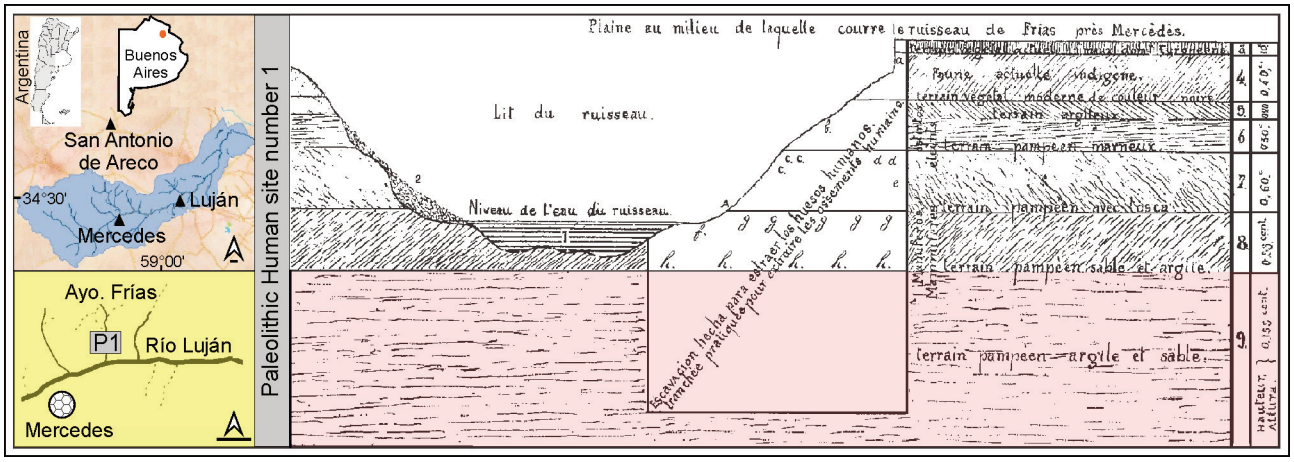


Figure 2. Paleolithic Human site number 1 ("Paradero" 1) of Ameghino (1878). Scale bar= 2 km.

earths. Among the faunal remains, he mentioned (*sic*) "*Hoplophorus ornatus* (Owen), *Hoplophorus Burmesteri* (Ameghino) *un Eutatus (Gervais de especie nueva)*, *Logostomus angustidens* (Burmeister), *Paleolama Weddelli* (P. Gervais), *Mylodón*, *dos especies de Murini*, *una o dos sp. de Ctenomys y* "*avestruz*" [*Hoplophorus ornatus* (Owen), *Hoplophorus Burmesteri* (Ameghino) a *Eutatus* (Gervais of a new species), *Logostomus angustidens* (Burmeister), *PaleolamaWeddelli* (P. Gervais), *Mylodon*, two species of *Murini*, one or two sp. from *Ctenomys* and an "ostrich"]. It is also mentioned that many of the faunal remains of Parad. h.p.n.1 were carbonized, splintered, and fluted, and this evidence showed anthropic intervention with the aim of marrow extraction.

Archaeological objects numbered consecutively from 52 to 272 are listed below. In no specific order, consecutive numbers from 52 to 62 were assigned to lithic materials such as arrowheads, scrapers, knapped stones, carvers, *etc.* Meanwhile, those numbered from 63 to 217 and 236 to 272

ÉPOQUES GÉOLOGIQUES.	PÉRIODES GÉOLOGIQUES.	ÉPOQUES ARCHÉOLOGIQUES.	SOUS-PÉRIODES.	ANIMALIA CARACTÉRISTIQUES.
Post-tertiaire.	Post-pampéen.	Néolithique.	Temps modernes.	Faune indigène actuelle de la Plata.
			Temps anciens.	Faune indigène actuelle de la Plata.
		Mésolithique.	Temps mésolithiques.	Faune presque identique à l'actuelle.
	Pampéen ou quaternaire.	Paléolithique.	Temps des grands lacs.	*Lagostomus fossilis*, *Canis Azaræ fossilis*, *Toxodon platensis*, *Lestodon myloides*, *Mastodon andium*.
			Temps pampéens modernes.	*Lagostomus angustidens*, *Canis protolupex*, *Ursus bonaerensis*, *Machairodus*, *Macrauchenia*, *Panochtus*.
			Temps pampéens antiques.	*Tipotherium cristatum*. *Hoplophorus ornatus*.

Figure 3. Cenozoic classification of Ameghino (1878).

correspond to osteological materials with some traces of anthropic intervention. The numerical segment that goes from 218 to 235 comprises the following objects: from 218 to 220 to different carved lithic pieces and an arrowhead; from 230 to 233 to burned earths; and from 234 to 235 to fragments of burned bone and charcoal. To each of these objects, Ameghino (1878) assigned a reference site corresponding to the place from where they were collected. He named those sites "*Paradero humano Paleolitico*" followed by the numbers 1, 2, 3, 4, 5, 6, or 7. The objects from these sites are not ordered according to their places of origin; for example, objects from Site 1 are interspersed with objects from Site 5 (see Supplementary Information 1).

The second subsection, Mesolithic Period, includes the objects numbered consecutively from 301 to 846. These were mainly collected from the human site on the right bank of the Cañada de Rocha and referenced with numbers 301 to 841. A few anthropic lithic elements were recovered in the Frías (numbered from 842 to 843) and Marcos Diaz (844 to 846) streams. Among the objects referred to Cañada Rocha, those numbered 301 to 510 correspond to human-made lithic materials. In contrast, number 511 is associated with a stoneware instrument attributed to the polishing of bone materials and 512 to 747 to bone elements which, for the author, are evidence of anthropic intervention linked to the processing and consumption of fauna or the manufacture of tools. Among the objects numbered 748 to 760 and 761 to 841, diverse remains of coloring matter and elements of pottery manufacture are listed, respectively.

The Neolithic Age is divided into three subsections, of which III and IV correspond to the elements generated by ancient inhabitants of the north of the Pampas region, assigned by Ameghino to the Querandí culture (1101 to 1887) and V to the objects recovered in the surroundings of Montevideo, Uruguay assigned to the Charrúas (2801 to 3070).

Subsection III is entitled "*Objets en pierre des anciens indiens Querandis*" and contains a large lithic group numbered from 1101 to 1887; only two blank entries can be observed, 1239 and 1303. The lithic elements assigned from 1101 to 1238 correspond to carved fragments without any typological distinctions. The numbers 1250 to 1389 represent, in general terms, knives, while the elements included within the range 1394 and 1576 represent arrowheads of different characteristics; from 1577 to 1597, small axes; 1586 to 1594, carved flints that could be used as saws; from 1595 to 1597, axes once again; from 1598 to 1604, knives; from 1605 to 1676, scrapers; 1677, a small axe; 1678 to 1710, scrapers; and from 1711 to 1887, interspersed mortars, large stone fragments, ornamental lithic fragments, *etc*.

Subsection IV, "*Poteries des anciens indiens quérandis*", includes a set of elements (2101–2551) that correspond to products and subproducts of the Querandí pottery industry such as potsherds, fragments of earth with evidence of thermic alteration, fragments of handles, and ornate fragments numerically interspersed with each other.

Subsection V, "*Objets en pierre et poter 1es des anciens indiens Charrúas*", comprises lithic pieces (2801–3052) and ceramic objects (3053–3070). The anthropological collection culminates with subsection VI, in which fragments of an aerolite are described and numbered from 4501 to 4503.

The Paleontology section was subdivided into four subsections entitled as follows: "*Fossiles quaternaires des pampas*" (subsection VII, from 4145 to 8520), "*Végétaux quaternaires des pampas*" (subsection VIII, without numbers), "*Fossiles préhistoriques modernes*" (subsection IX, from 6000 to 7000), and "*Géologie*" (subsection X, without numbers). Specimens included in subsection VII comprised fishes (from 5015–5018 and 5039), mollusks (8520), birds (4478, 4725–4745 and 6726), reptiles (4808–4819, 4876–4877, 4910–4914, and 5012–5013) and terrestrial mammals (the remaining numbers from 4145–8520). Among the latter, the ordering was based mainly on generic assignments, followed by specific and, only in some cases, supra-generic assignments. For example, the Paleontology section is headed by different fossil elements attributed to the felid *Machairodus necator* (Gervais) found in several localities in Buenos Aires Province. Specifically, the record begins with a canine found near Luján (4572), continues with a large part of a skeleton also found in Luján (4145), a pelvis from Pilar (5146–5147), a mandible with deciduous teeth, a part of a skull, atlas, *etc*. found in the Arroyo Frías (4746–4761), a femur collected near Mercedes (4829), and foot bones from Moreno (8000–8010). The following are the faunal remains of Felidae, Canidae, Moustelidae, bears, cervids, *Paleolama weddelli* (Gervais), smaller species of *Paleolama*, *Auchenia*, *Mastodon*, *Macrauchenia*, horses, toxodonts, glyptodonts, and "*armadillos*". This taxonomic arrangement is interrupted by the intrusion of two new epigraphs that include "Indeterminate" and "Unknown" vertebrates, which list faunal elements whose biological affiliation was still unknown for the exhibition in Paris.

It continues with the subsection "*Végétaux quaternaires des pampas*", which refers to 40 molds of fossil plants without numbering. Following is the subsection "*Fossiles préhistoriques modernes*", which includes remains of skunks, *guanacos*, deer, rodents, birds, lizards, fish, and malacological objects numbered from 6000 to 7000 that do not exhibit any numerical identification.

This section ends with the subsection "*Géologie*", in which samples were not numbered, and "*Travauxs cientifiques de l'exposant presents comme complement explicatif de ses collections*".

LA ANTIGÜEDAD DEL HOMBRE DEL PLATA (1880–1881)

The iconic work "*La Antigüedad del Hombre del Plata*" (from now on: "*La Antigüedad*") published by Ameghino (1880a, 1881), reported and illustrated different objects that were exhumed and collected from his early youth until shortly before he traveled to France to participate in the Universal Exposition in Paris in 1878. The objects and the report of his findings are systematized and detailed to fully support his theory on the temporality of the settlement

process in the Río de la Plata Basin. This work provided more details on the location and geology of human whereabouts. It showed for the first time the archaeological objects recovered by Ameghino in his different excursions or fieldworks in the Río de La Plata Basin. Recently, Simón *et al.* (2023) pointed out the coexistence in some objects of the original catalog number they had in the Special Catalog and that which reflects the image number in "*La Antigüedad*". This allowed the authors to demonstrate that these materials, currently housed in the Museo de La Plata, were part of the archaeological collection that Ameghino presented at the Universal Exhibition in Paris in 1878.

DISCUSSION

Temporality of the Ameghino collection: From the Quaternary "man" to the Pliocene "man"

A considerable number of the objects included by Ameghino in the Anthropological and Paleontological sections were temporarily assigned to the Quaternary as can be seen from the subtitles of the subsections and the general information of the Special Catalog of 1878.

Indeed, the specimens included in his Paleolithic times were consigned as "*Objets qui prouvent la contemporanéité de l'homme avec les grands anintauxéteintsqu'ontrouvedans le terrain quaternaire de la province de Buenos-Ayres*" (Objects that prove the contemporaneity of men with the large extinct animals found in the Quaternary terrain of Buenos Aires Province). In this subsection, Ameghino (1878 in Torcelli, 1914, p. 254) also mentioned that "*Tous les objets ci-dessusmentionnés ont été trouvés dans les couches de terrain quartenaire non remué mélangés à un très grand nombre d'ossements d'animaux éteints; ces faits prouvent jusqu'á l'évidence la contemporaneité de l'homme avec les grands mammifères quaternaires de l'Amérique du Sud. Une partie de ces spécimens ont été primés par la Socciété Scientifique Argentine á l'exposition et concours célebre le 28 Juillet 1875. Tous ces materiuax feront l'objet d'un ouvrage spécial que paraîtra prochainement sous le titre de L'antiquité de l'homme dans les contrées de la Plata."* (All objects mentioned above were found in the layers of undisturbed quaternary ground mixed with a very large number of bones of extinct animals; these facts clearly prove the contemporaneity of men with the large quaternary mammals of South America. Some of these specimens were awarded prizes by the Argentinian Scientific Society at the famous exhibition and competition on July 28th, 1875. All these materials will be the subject of a special work to be published shortly under the title "*L'antiquité de l'homme dans les contrées de La Plata*").

The assigned Quaternary temporality has its first appearance in a memory entitled "*El Hombre Cuaternario en la Pampa*" presented by Ameghino at the Sociedad Científica Argentina in 1876 (Ameghino, 1876a in Torcelli, 1914). Therefore, the quaternary temporality of the objects that were included in that catalog and later accompanied Ameghino to France had been taken into consideration by the Argentinian scientific community in 1876. This temporary assignment received international recognition with Ameghino's presentation in August of 1878 at the "*Congrès International des Sciences Anthropologiques*" in Paris (Ameghino, 1880b). This event was developed as one of the Universal Exposition of 1878 activities. In this presentation, Ameghino included a table in which the temporal relationships of the evidence were described and in which he obviously ratified the Quaternary position of the association of specimens assigned to the Paleolithic "man", the products generated by him, and his accompanying fauna from the deposits of the Pampean Formation (Fig. 3). However, later, the Quaternary assignment was questioned by Ameghino himself, when doubting the real geological age of the Pampean Formation (Fig. 4) (Ameghino, 1879). In fact, while still in France, he told the world: "*Invité par la rédaction de la «Revue d'Anthropologie», a donner un apercu de mon exposition préhistorique, j'ai cru que le mieux était de résumer en quelques pages mes études sur les époques préhistoriques de la Plata, qui paraîtront prochainement, en deux volumes, sous le titre de: l'Antiquité de l'homme dans la Plata*" (Invited by the editorial staff of the "*Revue d'Anthropologie*", in order to give an overview of my prehistoric exhibition, I thought it was best to summarize in a few pages my studies on the prehistoric periods of the Río de La Plata Basin, which will appear shortly in two volumes under the title: *L'Antiquité de l'homme dans La Plata*) (Ameghino 1879, p. 210). It is in this context that Ameghino (1879, p. 248) referred to the antiquity of the Pampean Formation in the following way: "*¿Quel est le veritable âge géologique de la formation pampéenne? Bravard, le premier qui l'ait étudiée sérieusement,*

la considère comme tertiaire... ...Burmeister... ...et presque tous les géologues contemporains disent au contraire qu'elle est quaternaire. Je partage l'opinion du premier. Dans mes precedentes Communications sur l'homme fossile argentin, faites, soit á la Société Scientifique Argentine, soit au dernier Congrés International des Sciences Anthropologiques ou á des journaux, j'ai toujours parlé de l'homme quaternaire dans la formation pampéenne; mais c'était seulement pour ne pas soulever deux questions en méme temps. Du reste il y a deja longtemps que dans un long mémoire sur la géologie des pampas, presenté a un concours public mais qui n'a pas été publié, j'ai cherché á démontrer que la formation pampéenne correspondait au pliocéne d'Europe et du Nord-Amérique" (What is the true geological age of the Pampean Formation? Bravard, the first who studied it seriously, considers it as Tertiary... .... Burmeister... ...and almost all contemporary geologists say the opposite, that it is Quaternary. I support the first opinion. In my previous Communications on Argentinian fossil man, made either to the Argentinian Scientific Society, or to the last International Congress of Anthropological Sciences or newspapers, I always spoke of Quaternary man in the Pampean Formation, but that was only in order not to raise two questions at the same time. Moreover, it has been a long time since in a long memoir on the geology of the *Pampas*, presented to a public competition, but which has not been published yet, I have sought to demonstrate that the Pampean Formation corresponds to the Pliocene of Europe and North America).

This assignment to the Pliocene markedly contrasts with the table published in the same work by Ameghino (1879), in which the Pampean Formation, with its Paleolithic "man" and accompanying fauna, is positioned in a post-Tertiary time (Fig. 4). The only exclusion registered concerning the table of the previous work corresponds to the Quaternary term. The unpublished work to which Ameghino (1879) referred corresponds to the memory that he presented in 1876 to the Sociedad Científica Argentina under the title "*Ensayos de un estudio de los terrenos de transporte cuaternarios de la provincia Buenos Aires*" (Ameghino, 1876b in Torcelli, 1914). In this memoir, Ameghino provided a set of geological and paleontological arguments in favor of the older position of the Pampean Formation concerning the Quaternary of Europe and North America, strongly suggesting that it could be assigned to the Pliocene. Although, at the same time, he recognized that this discussion was still a subject of study, depending on further data and research.

We must highlight that both works, "*El hombre cuaternario...*" and "*Ensayos...*", remained unpublished until 1914. However, both were simultaneously presented to the same scientific society in 1876 with self-exclusive temporal positions for the Pampean Formation: Quaternary vs. Pliocene. In this context, the argument offered by Ameghino, who avoided using the term Quaternary in his presentation, is weak because, from the beginning, he addressed both issues: the coexistence of men with megafauna and the Quaternary–Pliocene problem, which, although he carried it out in different presentations, were exhibited in the same society. On the other hand, what can be considered his first exhibitions with international projection such as his "Special Catalog" and the presentation of its contents at the "*Congrès International des Sciences Anthropologiques*", Ameghino positioned the Pampean Formation and its records within the Quaternary. This can be attributed to the fact that the assignment to the Pliocene was rejected by the vast majority of national and foreign naturalists who had dealt with the Pampas or, also, due to the doubts he expressed regarding certain paleontological aspects in his "*Ensayos de un estudio de los terrenos de transporte cuaternarios de la provincia Buenos Aires*" that, although it did not affect his decision to perceived it as Pliocene it did not allow him to discard the Quaternary. Then, it is highly probable that he took a conservative

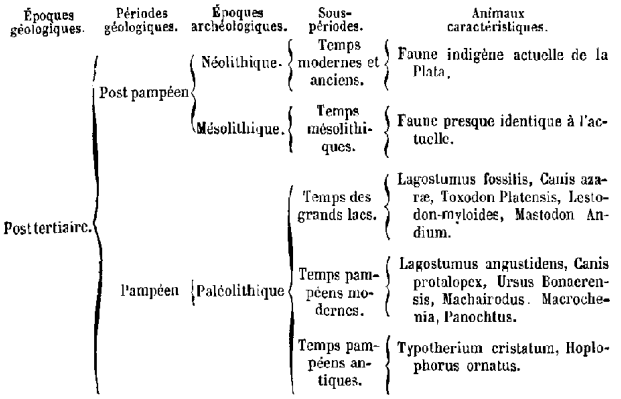
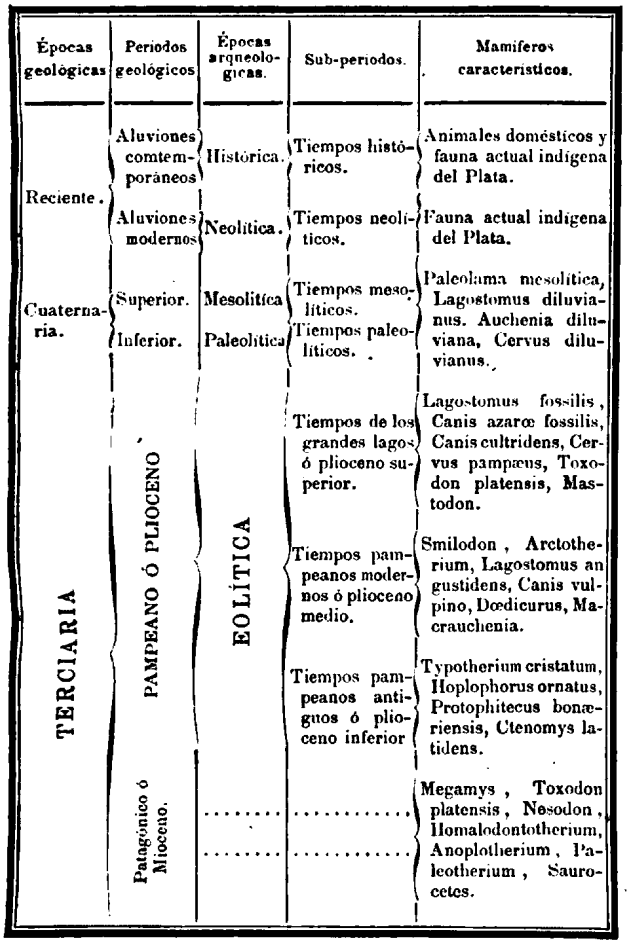


Figure 4. Cenozoic classification of Ameghino (1879).

position in the first exhibitions for the international public, in which he also represented the Argentinian Republic. For Florentino Ameghino, this discussion would represent part of his interests and scientific daily life in Europe. Its results could position him as an undisputed reference in the national and international paleontological-archaeological naturalists list.

We consider that it was the interaction and agreement of his ideas in the international arena which encouraged him in his book "*La Antigüedad*" (Ameghino, 1880a, 1881), that the Paleolithic "man" of the Quaternary of his monograph became the Pliocene "man" of the Tertiary of the Río de La Plata (Fig. 5). It is in "*La Antigüedad*" where he published and mixed all the discussion that began in his two presentations in 1876. The course of the discussion is accompanied by considerations regarding his colleagues in Argentina and, in particular, the person who was the Director of the Museo Público de Buenos Aires, Karl Hermann Konrad Burmeister (1807–1892). Ameghino (1881, p. 344–345) mentioned that: "*Bravard fué en sus clasificaciones mas lógico y esplícito... ...Considera la ... ... formación pampeana como terciario superior ó plioceno... ... Creo que Bravard es quien mas se ha acercado a la verdad. Por mi parte creo firmemente que la formación pampeana corresponde al terreno terciario superior de Europa... ...Pero Burmeister y casi todos los geólogos contemporáneos profesan ideas completamente opuestas. Consideran el terciario patagónico como plioceno, el pampeano como cuaternario y llaman aluviones modernos a todos los depósitos que se encuentran encima del terreno pampeano... ...Con todo, tengo la satisfacción de anunciar que todos los geólogos que hemos consultado personalmente y á quienes comunicamos las razones que nos inducen á creer que el terreno pampeano corresponde al plioceno de Europa, han concluido por darnos razón; omito aquí sus nombres, porque no quisiera que se creyera que con su autoridad busco á imponer mis opiniones*" (Bravard was logical and explicit in his classifications... ...He considers the... ... Pampean Formation as Upper Tertiary or Pliocene... ... I think that Bravard is the one who has come the closest to the truth. For my part, I firmly believe that the Pampean Formation corresponds to the upper Tertiary terrain of Europe... ...But Burmeister and almost all contemporary geologists profess completely opposite ideas. They consider the Patagonian Tertiary as Pliocene, the *Pampas* as Quaternary, and all deposits that lie on top of the *Pampas* terrain as modern alluvium... ...Nevertheless, I am pleased to announce that all the geologists that I have personally consulted and to whom I have communicated the reasons that lead me to believe that the *Pampas* terrain corresponds to the Pliocene of Europe, have concluded that I am are right; I omit their names here, because I do not want you to believe that I am trying to impose my opinions through the use of their authority).

In the selected passages, in addition to accounting for the changes in the temporality conceived for the records, the importance of the exchange with his colleagues from the old world is highlighted. In the new scheme of "*La Antigüedad*", Ameghino positioned men and the accompanying fauna in the novel Eolithic archaeological era. Such term was used for the first time in a book written by Gabriel de Mortillet (1821–1898) and his son Adrien de Mortillet



Épocas geológicas	Periodos geológicos	Épocas arqueológicas.	Sub-periodos.	Mamíferos característicos.
Reciente.	Aluviones comtemporáneos	Histórica.	Tiempos históricos.	Animales domésticos y fauna actual indígena del Plata.
	Aluviones modernos	Neolítica.	Tiempos neolíticos.	Fauna actual indígena del Plata.
Cuaternaria.	Superior.	Mesolítica	Tiempos mesolíticos.	Paleolama mesolítica, Lagostomus diluvianus. Auchenia diluviana, Cervus diluvianus.
	Inferior.	Paleolítica	Tiempos paleolíticos.	
TERCIARIA	PAMPEANO Ó PLIOCENO	EOLÍTICA	Tiempos de los grandes lagos ó plioceno superior.	Lagostomus fossilis, Canis azaræ fossilis, Canis cultridens, Cervus pampæus, Toxodon platensis, Mastodon.
			Tiempos pampeanos modernos ó plioceno medio.	Smilodon, Arctotherium, Lagostomus angustidens, Canis vulpino, Dœdicurus, Macrauchenia.
			Tiempos pampeanos antiguos ó plioceno inferior	Typotherium cristatum, Hoplophorus ornatus, Protophitecus bonæriensis, Ctenomys latidens.
	Patagónico ó Mioceno.	.....	.....	Megamys, Toxodon platensis, Nesodon, Homalodontotherium, Anoplotherium, Paleotherium, Saurocetes.

Figure 5. Cenozoic classification of Ameghino (1880a,1881).

(1853–1931), "*Museé préhistorique*" (De Mortillet & De Mortillet, 1881). Gabriel de Mortillet was a French archaeologist and political radical from whom Ameghino took the concept of the Eolithic and the prospecting of various archaeological sites around Paris. According to Ameghino (1881, p. 540–541) "*La denominación de eolítica, ha sido dada por el señor de Mortillet á la industria del hombre mioceno de Francia. Pero la misma denominación corresponde admirablemente á la mas antigua de las fases de evolución industrial, ó mas bien dicho á la primera de las fases industriales del Plata, correspondiente á los tiempos pampeanos. Pero tampoco quiero que por esto que se crea que quiero remontar la antigüedad del terreno pampeano hasta la época miocena. Se me preguntará igualmente donde coloco la época paleolítica; esta, lo repito, no se halla representada en el Plata, ó hasta ahora no se han encontrado sus vestigios"* (The denomination of eolithic has been given to the industry of the Miocene man of France by the lord of Mortillet. However, the same denomination corresponds admirably to the first phase of industrial evolution or the first of the industrial phases of La Plata, corresponding to the pampean times. But I do not want to believe that is why I intend to trace the antiquity of the Pampean terrain to the Miocene epoch. We will also be asked where we place the Paleolithic age. This, I repeat, is not represented in La Plata or, until now, its vestiges have not been found yet).

Finally, the Eolithic would become not only a new era for Ameghino but also irrefutable proof that he was in the world vanguard regarding the antiquity of human settlement in America.

The origin of 'things'

The beginning of the cataloging of the pieces that were the protagonists of Ameghino's worldwide projection can be settled before April 18th, 1876, at which time Ameghino sent his study on the "*El hombre cuaternario en la Pampa*" to the Sociedad Científica Argentina (1876a, p. 32, in Torcelli, 1914). By March of 1876, the Arroyo Frías region (Fig. 2) was well prospected and repeatedly sampled, as Ameghino (1889, p. 46) stated: "*En 1869 empezaba mis primeras escursiones en busca de fósiles, y contan buena suerte, que al año siguiente (l870), descubría un cráneo y partes considerables de un esqueleto de hombre fósil que fué llevado á Europa por un coleccionista y regalado al Museo Cívico de Milán, pieza que todavía no ha sido descripta. Tres años después, descubría en el mismo punto (Arroyo de Frías, cerca de Mercedes) nuevos fragmentos de huesos fósiles humanos, y sucesivamente aumentaba mis datos con numerosos objetos trabajados ó que llevaban impresa la acción de la mano del hombre, recogidos en el terreno pampeano de Mercedes y de Lujan, conjuntamente con los restos de grandes edentados extinguidos."* (In 1869, I began my first excursions in search of fossils, and with such good luck, in the following year (1870) I discovered a skull and considerable parts of a fossil human skeleton that was taken to Europe by a collector and given to the Civic Museum of Milan, a piece that has not been described yet. Three years later, I discovered at the same point (Arroyo de Frías, near Mercedes) new fragments of human fossil bones and, successively, I increased my data with numerous worked objects or that had the action of the hand of man printed on them collected in the Pampas terrain from Mercedes and from Lujan together with the remains of large extinct edentates). Prospecting and collecting in the Arroyo Frías region continued at least until 1874, as can be inferred from the data included in "*La Antigüedad*" (Ameghino, 1880a, 1881).

The Paleolithic subsection of the Anthropology section of the Special Catalog contains numbered objects that Ameghino partially listed in the catalog that accompanied his presentation of "*El hombre cuaternario de la Pampa*" (Ameghino, 1876a, in Torcelli, 1914; see Supplementary Information 1). The numerical sequence 1 to 19 corresponded to the human skeletal remains recovered in Arroyo Frías, which also headed the Special Catalog but with the number 1031. When examining the number of pieces assigned to the human skeleton in both catalogs, it turns out that there are 50 bone elements. In effect, Ameghino in the 1876 catalog (Ameghino, 1876a, in Torcelli, 1914, p. 36) recognized that the specimen was constituted by "…*Un diente incisivo inferior, cuatro vértebras, cinco pedazos de costillas, siete huesos del metacarpo y metatarso y dos falanges. Quedan aún en mi poder parte de la cadera y unos treinta huesos diferentes*" (…A lower incisor, four vertebrae, five pieces of ribs, seven metacarpal and metatarsal bones, and two phalanges. Part of the hip and about thirty different bones are still in my possession). This sum of 50 bone elements coincides with

the detail that Ameghino recorded in the Special Catalog of osteological elements grouped under the number 1031. The Special Catalog (Ameghino, 1878 in Torcelli, 1914, p. 243–244) states: "*1031. Une dent incisive inférieure, partie du bassin, quatre vertebres et 44 os et fragments d'os divers appartenant a l'homme fossile, trouvés sur la rive gauche du petit ruisseau de Frías, prés de Mercedes, province de Buenos-Ayres, dans un terrain quaternaire non remué er îi une profondeur de 3 á 4 métres*" (1031. A lower incisor, part of the pelvis, four vertebrae, 44 bones, and various bone fragments belonging to the fossil man were found on the left bank of the small stream of Frías, near Mercedes, Buenos Aires Province, in an undisturbed quaternary soil at a depth of 3 to 4 meters). Gathering the data from both catalogs we suggest that number 1031 of the Special Catalog corresponds to the elements of series 1 to 51 of the 1876 catalog. Ameghino usually resorted to numerical grouping to assign a set of objects of the same genesis or morphology and such is the case, for example, of the set of objects consigned with the numbers from 63 to 72 in the Special Catalog (see Supplementary Information 1). Therefore, our hypothesis would gain strength, although the sequence used in 1876 is lower than that of 1878. However, it must be considered that Ameghino acknowledged he did not include all the bone elements of the human specimen in the 1876 catalog (Ameghino, 1876a, p. 36 in Torcelli, 1914).

Both catalogs, the one from 1876 and the Special Catalog, aim to publicize the findings from the Arroyo Frías (bio-anthropological remains, lithic, sedimentary, and bone elements that evidenced anthropic activity and accompanying fossil mammals). In the Special Catalog, the author advanced in the temporal and spatial contextualization. On th eother hand, the 1876 catalog does not specify the geographic provenance of the specimens, including the reference only as: "near Luján", "Mercedes", or "San Antonio de Areco" and, in some cases, this general information was absent; whereas in the Special Catalog, this information is very detailed throughout the entire work. He assigned the provenance of the objects included in the 1876 catalog as Paleolithic human sites number 1, 2, 3, and 4 (see Supplementary Information 1). This detailed control of the origin of the evidence became vital in the construction of its temporary repositioning concerning the antiquity of the geological deposits from which it was extracted and, therefore, of the antiquity of the human presence in the La Plata Basin.

Finally, although the Special Catalog represents an advance in the knowledge of the temporal and spatial context of the objects in the collection that traveled to Paris and were materialized in the "*La Antigüedad*", the structuring of the Special Catalog disarticulated much of the evidence that accounted for the coexistence of men with paleofauna. In this regard, in the 1876 catalog, we can see that the exoskeleton of a glyptodont specimen assigned to *Hoplophorus* is mentioned among the anthropic evidence (see number 82 in Supplementary Information 1). In contrast, in the Special Catalog this specimen is listed in the Paleontology section under the number 4850. This change responds to the fact that Ameghino's Special Catalog was dichotomously structured, classifying its collection into Cultural Materials vs. Natural Materials. Ameghino (1878) dissociated the contexts of findings by his determination to place the objects in one of the sections (Anthropology/Paleontology). Thus, although coming from the same location or archaeological site and even from the same sedimentary deposit of the archaeological site, the fossils came to constitute different collections and had divergent destinations. An emblematic case is the material and biological evidence exhumed from layer 9 of Paleolithic human site number 1. The cultural objects assigned to lithic manufacture, the bone remains intervened anthropically, and even the human bone remains from layer 9 are listed in the Anthropology section of the Special Catalog. Meanwhile, the remains of *Machairodusnecator* (Fig. 6)*, Eutatus* n. sp. (Fig. 7), and *Hoplophorus burmeisteri* are part of the Paleontology

Figure 6. Mandible assigned to ***Machairodus necator*** by Ameghino (1878). Special Catalog 4746. **AMNH 11102**. Scale bar= 10 mm.

Figure 7. Skull in ventral view assigned to ***Eutatus*** n. sp. (Ameghino, 1878). Special Catalog 4836. **AMNH 11231**. Scale bar= 25 mm.

section with numbers 4746–4761, 4836, and 4850, respectively. As for the divergent destinations, these remains exhibited in Paris as evidence of the coexistence of "man" with extinct fauna were sold to Edward Drinker Cope in 1879, transported to the Philadelphia Museum, and are currently housed in the American Museum of Natural History (AMNH) in New York (Osborn, 1903).

Post-formation: Separate destination

The Ameghino Collection that traveled to Paris was fragmented as a result of commercialization, donations, and exchanges (Podgorny, 2000) and as Casinos (2012, p. 75) mentioned: "*... el material que había transportado iría a enriquecer diversos museos, entre ellos los de París y Nueva York*" (... the material that was transported would go on to enrich various museums, including those in Paris and New York). The issue of the commercialization of a part of the private collection that Ameghino exhibited in Paris was controversial in the scientific community at that time (Podgorny, 2000; Toledo, 2016) and continues today (Toledo, 2016). Podgorny (2000) placed this issue in context. In the 19th century Argentina, the commodification of archaeological pieces, ethnographic objects, fossil remains, and exotic organic and inorganic objects was a common practice. Ameghino counted for commercial transactions and/or donations and exchanges with the approval of the Argentinian Commission. According to Podgorny (2000, p. 32), the argument of the criticism of the behavior adopted by Ameghino "*...no recurría a la argentinidad de los restos sino a la necesidad para los científicos radicados en la Argentina de contar con colecciones valiosas para poder realizar su trabajo*" (...did not turn to the Argentinian nature of the remains, but rather to the need for scientists in Argentina to have valuable collections in order to carry out their research). The current controversy lies in the assessments regarding whether the sale only concerned paleontological objects or archaeological objects. For Podgorny (2000), the sale of archaeological objects would have been possible, while Toledo (2016, p. 174) maintained that: "*Ameghino no vende su colección de objetos relativos al hombre ya que era la base material que testimoniaba su hipótesis más preciada, la coexistencia del mismo con la megafauna*" (Ameghino did not sell his collection of objects related to men because it was the basic material that supported his most precious hypothesis, its coexistence with the megafauna). Although we have not found evidence to support that Ameghino sold objects cataloged in the Anthropology section of the Special Catalog, we consider that Ameghino did sell archaeological evidence related to the emblematic location of human antiquity in the Río de La Plata. This statement is based on the sale of the pieces under numbers: 4836 for the specimen *Eutatus* n. sp., remains 4850 of *Hoplophorus burmeisteri*, and the pieces numbered as 4746–4761 of the specimen *Machairodus necator* from the Paleolithic Human site number 1. These remains, associated with anthropogenic materials and bioarchaeological remains, conformed to an archaeological context. It is not necessary to appeal, then, to an actualistic analogy for the concept of archaeological site (*e.g.*, Deetz, 1967; Shiffer, 1972; Butzer, 1982). It is Ameghino himself who gives the entity of human whereabouts to the locus of discovery. The evidence that today would constitute the archaeofaunistic record or also named as zooarchaeological record gave his sites one of the fundamental topics of archeology: temporality.

CONCLUSION AND FINAL THOUGHTS

From the hand of Florentino Ameghino, the collection of objects that build up the Anthropology section of the Special Catalog exhibited in Paris positioned the Río de La Plata basin in the world debate regarding the characteristics and antiquity of the settlement process and its sociocultural development (*e.g.*, Lehmann-Nitsche, 1907, 1910; Mochi, 1910; Hrdlička, 1912; Podgorny, 2009; Politis, 2014). According to the structure and information presented in the Special Catalog, it is reasonable to think that it formed

a fundamental pillar in the conception and execution of the most important work of archaeological literature on the Río de La Plata Basin. Nowadays, the scientific community returns again and again with new techniques and approaches to the objects of the Ameghino collection, for the recognition and discussion of the biological and cultural characteristics of the social actors who carried out the settlement process of South America (*e.g.*, Bonomo, 2002; Toledo, 2005, 2011, 2016, 2021; Politis & Bonomo, 2011; Bonomo & Scabuzzo, 2016; Chichkoyan, 2019; Politis *et al.*, 2019; Acosta *et al.*, 2020). The new investigations have promoted the sites' geolocation, provided accurate radiometric dating, and reviewed the genesis and characteristics of the sedimentary deposits that bore the evidence and the proposed associations. Nevertheless, there is an aspect that, up to now, has not been fully discussed yet. That is the incidence that the primary distinction between natural and cultural objects had in the curatorial destinations of the evidence and interpretation of the contexts of findings. The differentiation proposed by Ameghino in his catalog influenced the final destination of the objects he recovered, having sold a significant number of pieces considered by him of a paleontological origin and by us as archaeofaunistic, since those were recovered from human sites.

The findings that at the time materialized the antiquity and continuity of the human settlement in the Rio de La Plata Basin are today institutionally divorced under different curatorships. On the one hand, those objects that were sold are currently housed in foreign collections, while those that returned from Paris are housed in the Museo de La Plata. At this institution, some are part of the Vertebrate Paleontology collection. Meanwhile, what was cataloged in the Anthropology section of the Special Catalog constitutes one of the foundational collections of the Archeology Division of the same institution.

The study of the conformation, classification, and recreation of the life history of the Ameghino collection highlights the limitations of the dichotomous conception that separates cultural history from natural history in curatorial policies and, in some cases, in the scientific policies of museological institutions. These limits have affected the deconstruction of records that were associated with one of the most important collections of the world heritage since it houses a large part of the South American Cenozoic fossil mammals and one of the oldest bioanthropological records in the history of human population from South America (*e.g.*, Politis, 2014; Borrero, 2015). We consider that the contextual dissociation and logistical divorce of the Ameghino collection exhibited in Paris has consequences which, as sequels, invade the resolution characterizing the natural and/or cultural processes involved in the conformation of the record. In this sense, a question arises: Can we generate new results for interpreting the Parad. h.p.n.1, if we give the faunal record from layer N° 9 an archaeofaunisitic entity? We do not have a definitive answer but we do suspect that it is possible to offer interpretive variants if the associations of the bone assemblages that made up the Paleontology section of the Special Catalog are reanalyzed with the evidence that went on to make up the Anthropology section of the same catalog.

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THE LELONG THÉVENET COLLECTION AND ITS FINAL DESTINATION: RECOVERY OF TYPE AND REFERRED MATERIALS OF CINGULATES DESCRIBED BY AMEGHINO

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Abstract. At the end of the 19th century, Ameghino studied the fossils of the "*conglomerado osífero*" (Late Miocene, Paraná, Entre Ríos, Argentina), erecting at least 13 new species of cingulates. Some of the type specimens of these species have been considered lost, relying only on the descriptions of Ameghino and some figures of the type or referred materials of his 1889 atlas. The specimens described by Ameghino belonged to private (*e.g.*, Lelong Thévenet, Ameghino) and public collections (*e.g.*, those of Professor Scalabrini). This work aims to record the type specimens and referred materials of Cingulata within the Lelong Thévenet Collection and deposited in the collections housed at the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia". The Lelong Thévenet Collection was acquired by this institution in 1886, but the specimens were formally included, at different times, in the Colección Nacional de Paleovertebrados. An exhaustive search of the cingulate specimens referred to said collections was carried out, which resulted in the identification of several of them in Ameghino's 1889 atlas. We found materials collected by Lelong Thévenet and Ameghino in the Colección Nacional de Paleovertebrados and Colección Nacional Ameghino, respectively. Many of these materials have been recognized as type specimens or referred materials of these armored mammals, identifying 10 original materials, of which four correspond to holotypes and six to referred materials; added to these, 17 casts were identified, six of them from holotypes and the other 11 referred by Ameghino in his atlas.

Key words. Fossil mammals. Lelong Thévenet Collection. Ituzaingó Formation. Holotypes. Referred materials. Ameghino.

Resumen. LA COLECCIÓN LELONG THÉVENET Y SU DESTINO FINAL: RECUPERACIÓN DE MATERIALES TIPO Y REFERIDOS DE CINGULADOS DESCRIPTOS POR AMEGHINO. A finales del siglo XIX Ameghino estudió los fósiles del "conglomerado osífero" (Mioceno Tardío, Paraná, Entre Ríos, Argentina) erigiendo al menos 13 nuevas especies de cingulados. Algunos de los ejemplares tipo y materiales referidos de estas especies se han considerado extraviados, contando solo con las descripciones de Ameghino y algunas figuras en su atlas de 1889. Los especímenes descriptos por Ameghino pertenecían a colecciones privadas (*e.g.*, Lelong Thévenet, Ameghino) y estatales (*e.g.*, la del Profesor Scalabrini). El objetivo de este trabajo fue registrar los ejemplares tipo y materiales referidos de Cingulata pertenecientes a la Colección Lelong Thévenet, depositados en las colecciones del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia". La Colección Lelong Thévenet fue adquirida por dicha institución en 1886, pero los ejemplares fueron ingresados formalmente en diferentes instancias a la Colección Nacional de Paleovertebrados. Se efectuó una exhaustiva búsqueda de los ejemplares de cingulados que estuviesen referidos a dichas colecciones, resultando en la identificación de varios de ellos figurados en el Atlas de Ameghino de 1889. Se han encontrado materiales colectados por Lelong Thévenet y Ameghino en la Colección Nacional de Paleovertebrados y la Colección Nacional Ameghino, respectivamente. Estos materiales han podido ser reconocidos como ejemplares tipos o referidos de estos mamíferos acorazados, identificándose 10 especímenes originales, de los cuales cuatro corresponden a materiales tipo y seis a materiales referidos; además se identificaron 17 calcos, seis de ellos correspondientes a copias de holotipos, mientras que 11 son calcos de materiales referidos por Ameghino en su atlas.

Palabras clave. Mamíferos fósiles. Colección Lelong Thévenet. Formación Ituzaingó. Holotipos. Materiales referidos. Ameghino.

BETWEEN 1883 and 1889, Florentino Ameghino (1854–1911) established diverse species of mammals from fossil specimens recovered from the "*conglomerado osífero*" (Late Miocene) of Paraná locality (Entre Ríos Province, Argentina) among which, at least, 13 corresponded to cingulates. As was customary at the time, Ameghino never published the new species with their associated catalog numbers, nor gave them typological assignments (*e.g.*, type material); but

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in many cases, he specified the collector of each specimen on which he based his new taxa and descriptions (Ameghino, 1883a, 1883b, 1885, 1886, 1889). Until 1889, all the species of cingulates erected by Ameghino (1883a, 1883b, 1885, 1886) only had a description, which in some cases, were very brief and lacked illustrations. Fortunately, in his exceptional publication about the fossil mammals of Argentina, Ameghino (1889) illustrated 23 materials representing 10 species among the 13 taxa of cingulates recovered from the "*conglomerado osífero*" established and described by Ameghino (1883a, 1883b, 1885, 1886, 1889).

The cingulate specimens studied by Ameghino (1883a, 1883b, 1885, 1886, 1889) belonged to both private and public collections. Within the latter was the one constituted by the Italian professor and naturalist Pedro Scalabrini (1848–1916), who gathered an extensive collection of fossils from the cliffs exposed at Paraná (*e.g.*, Ameghino, 1883a, 1883b, 1885, 1886; Cione *et al.*, 2000; Velázquez, 2007; Scillato-Yané *et al.*, 2013; Contreras *et al.*, 2019), housed at the Museo Provincial del Paraná (Entre Ríos Province, Argentina) (Ameghino, 1885, 1886; see also Museo Provincial de Entre Ríos in Ameghino, 1889). This museum closed in 1904 and its collections were transferred to the Escuela Normal de Paraná (see Velázquez, 2007) and the Museo de Ciencias Naturales y Antropológicas "Antonio Serrano" (MAS, Entre Ríos Province, Argentina) (see Scillato-Yané *et al.*, 2013) or possibly both institutions according to Contreras *et al.* (2019). The fossil cingulates stored at the MAS were studied by Scillato-Yané *et al.* (2013), who identified three type specimens and tracked down the historical background of the materials: 1- Scalabrini collected the materials; 2- he sent them to Ameghino in Buenos Aires; 3- Ameghino analyzed and described the materials, and, in some cases, made casts; 4- Ameghino returned them to Scalabrini, where they were finally stored in Paraná.

Regarding the private collections, Ameghino (1886, 1889) mentioned his studies were made based on Mr. Leon Lelong Thévenet's and his own collections. Both collections were purchased in 1886; the former by the Museo Nacional (nowadays Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" and Instituto Nacional de Investigación de las Ciencias Naturales—MACN—; for a review of the names of this institution see Castello & Piacentino, 2015), and the latter by the Museo de La Plata (MLP) (Moreno, 1886, 1890; Ameghino, 1889; Farro, 2008, 2009; Fernicola, 2011a). Consequently, the original specimens described by Ameghino during almost a decade (1883a, 1883b, 1885, 1886, 1889) and later figured (Ameghino, 1889) followed the same, tortuous historical path. Unfortunately, most of the specimens at the MACN were cataloged in the mid-20th century without acknowledging that many of them had been studied by Ameghino and did not consider his taxonomic assignations (Cruz & Fernicola, 2022); while those at the MLP were subjected to the confrontation between Francisco Pascasio Moreno (1852–1919) and Florentino Ameghino, Director and Sub-Director of this institution, respectively (Fernicola, 2011a).

Contrasting, perhaps, with the history of the specimens collected by Scalabrini, the lack of clarity in the historical sequence of Lelong Thévenet's collections led many specimens, including type materials, to be considered lost for many years (*e.g.*, Mones, 1986; Kinderknecht, 1999; Scillato-Yané *et al.*, 2013).

In this context, the objective of this work is to account for the historical course of the Lelong Thévenet Collection mentioned by Ameghino, purchased by the then Museo Nacional and currently deposited in the Colección Nacional de Paleovertebrados (MACN-PV) at the MACN in order to identify the type specimens and referred materials of Cingulata that are part of this acquisition. In addition to this, we identified type and casts of the types of cingulates of the "*conglomerado osífero*" described by Ameghino and collected by Scalabrini and Ameghino, which are housed in the Colección Nacional Ameghino (MACN-A) at the MACN.

HISTORICAL BACKGROUND

Ameghino began studying the fauna from the "*Piso Mesopotamiense*" or "*conglomerado osífero*" in 1883, from a few materials that Scalabrini brought to Buenos Aires. Ameghino (1883a), in this first work, established three new species within Cingulata: *Chlamydotherium paranense*, *Glyptodon* (?) *antiquus*, and *Hoplophorus paranensis*. Then, in a second work, based on new materials given by Dr. Estanislao S. Zeballos on behalf of Scalabrini, Ameghino (1883b) established within Cingulata one new genus—*Palaehoplophorus*—and added new materials to

Palaehoplophorus scalabrinii [=*Glyptodon* (?) *antiquus*, see below], *Chlamydotherium paranense*, and *Glyptodon elongatus*. Later, Ameghino (1885) mentioned that in October of 1884, he visited the Paraná city, studied the materials housed at the Museo Provincial del Paraná, and went to the field, in some opportunities with Scalabrini (Ameghino, 1885; Tognetti, 2001). These explorations were financially supported by the Academia Nacional de Ciencias (Tognetti, 2001). As a result, Ameghino (1885) established three new species: *Palaehoplophorus pressulus*, *Euryurus interundatus*, and *Protoglyptodon primiformis*; in addition, he described more materials of two known taxa: *Palaehoplophorus scalabrinii* and *Chlamydotherium paranense* and described two materials as indetermined Cingulata. Ameghino (1885) also mentioned that pictures of each material would be released in future publications as soon as he obtained the resources for it.

Afterwards, Ameghino (1886) continued analyzing this fauna, establishing once again within Cingulata, three new species: *Comaphorus concisus*, *Chlamydotherium*? e*xtremum*, and *Proeuphractus limpidus*. Based on new materials, he also extended the description of five previous taxa (*Hoplophorus paranensis*, *Palaehoplophorus scalabrinii*, *Euryurus interundatus*, *Protoglyptodon primiformis*, and *Chlamydotherium paranense*). In addition, Ameghino's (1886) work highlighted the valuable collections built around the fauna of "*conglomerado osífero*", including the collections of the Museo Provincial del Paraná and the Museo Nacional (=MACN). Ameghino (1886, p. 3–4) specifically mentioned a large collection of fossil mammals that belonged to Lelong Thévenet and, later, he wrote that this collection was acquired by the Museo Nacional.

Finally, Ameghino (1889) described and figured many materials of this fauna and, within the Cingulata, established three new species: *Hoplophorus verus*, *Lomaphorus cingulatus*, and *Pseudoeuryurus lelongianus*, and extended the description of nine previously described taxa (*Palaehoplophorus scalabrinii*, *Palaehoplophorus pressulus*, *Hoplophorus paranensis*, *Protoglyptodon primiformis*, *Neuryurus interundatus*, *Comaphorus concisus*, *Chlamydotherium paranense*, *Chlamydotherium*? e*xtremum*, and *Proeuphractus limpidus*), based on specimens recovered from Paraná's cliffs.

Until now, the Paraná's cliffs yielded several fossil's remains recovered from two units: the Paraná and Ituzaingó formations (see Cione *et al.*, 2000; Brunetto *et al.*, 2013; Perez, 2013). The lower member of the Ituzaingó Formation was traditionally known as the "*conglomerado osífero*" and/or "*Piso Mesopotamiense*" (see Cione *et al.*, 2000; Brandoni, 2013; Schmidt *et al.*, 2020, and references therein). According to Cione *et al.* (2000), and following the geochronologic and chronostratigraphic formal scheme based on biostratigraphic units and defined by mammalian Biozones (see Cione & Tonni, 1995, 2005, and references therein cited), the "*conglomerado osífero*" or "*Piso Mesopotamiense*" has been referred to the Huayquerian Stage/Age (*ca.* 8.7–6.8 Ma). However, recent faunistic analysis indicates that this faunal assemblage is a mixture of faunas assigned to the Chasicoan and Huayquerian stages/ages, deposited during the end of the Tortonian or the early Messinian (Brandoni, 2013; Schmit *et al.,* 2020). It is important to mention here that the Huayquerian Stage/Age at its type locality was recently reviewed and redefined (Romano *et al.*, 2023).

MATERIALS AND METHODS

The types and assigned specimens of the species erected by Ameghino between 1883 and 1889, regrettably, were not identified with a collection number. In order to identify the types and referred materials of the studied species, we thoroughly reviewed numerous specimens deposited at the MACN-A and MACN-PV collections, comprising mainly isolated osteoderms, fragments of the dorsal carapace, and fragment of the caudal tubes. These materials were contrasted with the original descriptions and supplementary data, such as measurements and illustrations, published between 1883 and 1889 by Ameghino. According to Ameghino (1886) the fossil specimens from Lelong Thévenet's collection had been purchased by the Museo Nacional that same year. Therefore, we firstly focused our search of the materials at the MACN-PV. We also extended our search to the MACN-A collection because it was Ameghino's personal.

The information was gathered from notes and books preserved at the *Archivo Histórico* of the MACN (*e.g.*, "*Inventario Museo de Buenos Aires 1850–1891*"), Ameghino's handwritten catalog, an entrance book of the MACN-PV,

and the multiple publications of Ameghino (1883a,1883b, 1885, 1886, 1889). Especially important are the illustrations published by Ameghino (1889) in different plates (see results for details), which, in some cases, completed the description of the taxa published in the previous years. We want to emphasize that in this contribution we provide new descriptions of the original recovered materials, but we do not make any evaluation on the validity of the species and genera. Consequently, we prefer to follow the systematic scheme and taxonomic nomenclature of Ameghino (1889). Nevertheless, with regards to *Glyptodon* (?) *antiquus* of Ameghino (1883a) = *Palaehoplophorus scalabrinii* of Ameghino (1883b), the specific name is different because this taxon had a particular nomenclatural problematic. In this sense, this contribution follows the regulations established by the ICZN (1999) concerning the selection of type specimens, type species, and nomenclatural problems. Therefore, in this work we write it correctly like as *Palaehoplophorus antiquus* (Ameghino, 1883a) in accordance to Scillato-Yané *et al.* (2013).

The terminology used for the anatomical description follows Cruz *et al.* (2011) and Porpino *et al.* (2014) for glyptodonts, Gois *et al.* (2015) for pampatherids, and Fernicola *et al.* (2021, and references therein) for dasypodids.

All materials were analyzed by direct observations and, in some cases, under a magnifier lamp (3x). The measurements indicated in this contribution were taken with a Kendo digital caliper (0.02 mm). The photographs were taken with a Panasonic DMC-TZ57 20X camera.

Institutional Abbreviations. MACN, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Ciudad Autónoma de Buenos Aires, Argentina; **MACN-A,** Colección Nacional Ameghino at the MACN, Ciudad Autónoma de Buenos Aires, Argentina; **MACN-PV,** Colección Nacional de Paleovertebrados at the MACN, Ciudad Autónoma de Buenos Aires, Argentina; **MAS,** Museo de Ciencias Naturales y Antropológicas "Prof. Antonio Serrano", Paraná, Entre Ríos, Argentina [= **MASP** following Brandoni (2013) and Schmidt & Cerdeño (2013), = **MPCNP,** Museo Provincial Ciencias Naturales de Paraná, Entre Ríos, Argentina, following Mones (1986)]; **MLP,** Museo de La Plata, La Plata, Argentina.

RESULTS

Acquisition of the Lelong Thévenet Collection by the Museo Nacional (=MACN)

There are several documents at the MACN, some only paper and others paper and digitized data, which allowed us to re-construct the history of the purchase of the Lelong Thévenet Collection. In the *Archivo Histórico* of the MACN we found a document (see Supplementary data 1) with different notes about this subject: one note in particular, dated on February 4th, 1886, addressed to the Minister of Public Instruction Dr. D. Eduardo Wilde, signed by Dr. German Burmeister, explains the following: *"El Sr. D. Leon Lelong Thévenet, de Paraná, ha ofrecido al Museo Nacional su colección de Fósiles de la Formación Terciaria del Paraná, que, según el catálogo que me ha remitido, enumera 715 objetos diferentes, entre los cuales figuran algunos, especificados por dibujos provisorios, de mucho valor y hasta hoy desconocidos, faltando no solamente éstos sino tambien muchos otros de entre ellos en el Museo. Como esta colección dará un suplemento muy valioso á la de Bravard, recién examinada por mí en la última entrega (XIV) de los Anales del Museo, me parece una adquisición á propósito, y propongo aceptar la oferta hecha por el precio de 2000 pesos nac. que el propietario pide, previa inspección exacta, á la cual me ofrezco, con la asistencia del Naturalista viajero del Museo, D. Enrique de Cárles."* (Mr. D. Leon Lelong Thévenet, from Paraná, has offered to the Museo Nacional his collection of fossils from the "*Formación Terciaria*", of Paraná, which according to the catalog he has sent, consists of 715 different objects, including some, specified by provisional drawings, highly valuable and until today unknown, missing not only these but also many others among them in the museum. As this collection will provide a very valuable supplement to that of Bravard, recently examined by me in the last edition (XIV) of the *Anales del Museo*, it seems to me a deliberate acquisition, and I propose to accept the offer made for the price of 2000 national *pesos* that the owner requests, previous thorough inspection, to which I offer myself, with the assistance of the traveling naturalist of the Museum, Mr. Enrique de Carles). Burmeister also offers a proposed payment plan for that sum starting at the amount of 500 (fixed sum per month awarded for the increase of the Museum's collections). Afterwards, another note signed by *Conta. Gral*

(=*Contaduría General de la Nación*) dated on February 8th, 1886, said: *"Atento lo manifestado por el Director del Museo Nacional en la adjunta nota, toca a V.E resolver á su respecto lo que crea oportuno"* (Considering to what was manifested by the Head of the *Museo Nacional* in the attached note, it is up to Your Excellency to resolve what you deem appropriate). Subsequently, with a note dated on February 17th, 1886, the President of Argentina (by that time, Julio Argentino Roca) resolved: *"que se ponga a disposición del Mencionado Director la cantidad de dos mil pesos moneda nacional destinada á adquirir la colección de fósiles que ha ofrecido en venta Don Leon Lelong Thévenet, con destino al Museo Nacional, imputándose dicha suma al Inciso 12, Item 9 Partida 9 del presupuesto vigente"* (that the amount of two thousand *pesos* national currency be made available to the aforementioned Director to acquire the collection of fossils that Don Leon Lelong Thévenet has offered for sale, destined for the *Museo Nacional*, charging said sum to Subsection 12, Item 9, Section 9 of the current budget). This letter was signed by Eduardo Wilde. Then, in another note dated March 10th, 1886, addressed to Mr. Wilde, and signed by Dr. Burmeister, it reads: *"Por nota de V.E. fecha 17 de Febrero ppdo., estoy autorizado para comprar la colección de fósiles ofrecida al Museo Nacional por D. Leon Lélong Thévenet, del Paraná, por el precio de 2000 pesos nacionales. Conforma con mi oferta, pienso ir al Paraná á principios del mes de abril, acompañado por el naturalista viajero del museo D. Enrique de Cárles y mi hijo, Ayudante del mismo establecimiento, para inspeccionar la colección y adquirirla por el precio estipulado, si la encuentro conforme con las indicaciones de su propietario, y arreglar su embalaje por las personas que me acompañan, para ser transportada al Museo. Ruego entónces a V.E. ordenar se entreguen á mi órden los 2000 pesos para no retardar el pago del vendedor..."* (By note of Your Excellency dated February 17, I am authorized to buy the collection of fossils offered to the *Museo Nacional* by Mr. Leon Lélong Thévenet, from Paraná, for the price of 2000 national *pesos*. In accordance with my offer, I plan to go to Paraná at the beginning of April, accompanied by the traveling naturalist from the museum, D. Enrique de Cárles, and my son, assistant of the same establishment, to inspect the collection and acquire it for the stipulated price, if it is in accordance with the indications of its owner, and arrange its packaging by the persons who accompany me, to be transported to the Museum. So, I request Your excellency that you order the 2000 *pesos* be delivered to me so as not to delay the seller's payment). Finally, on March 16th, 1886, the payment was approved and the director of the museum was informed. Added to these notes there is a detail of different expenditures of the museum for the year 1886, where in March 1886 the costs of the expedition to Paraná are specified (see Supplementary data 1).

In addition, we found another document in the *Archivo Histórico* of the MACN, which is the "*Inventario Museo de Buenos Aires 1850-1891*", recording the museum's possessions and the various incomes from 1850 to 1891. On page 107 of this inventory (p. 126 of the digitized document, Fig. 1.1) there is a record indicating the entry to the museum of the Lelong Collection with date April 15th, 1886: *"La colección de fosilis del Paraná, comprado de D. Leo Lelong, ha sido traído por el Naturalista viajero, en cinco grandes cajones. Pronto lo he examinado y dado velación al Ministro por nota el 26 de Abril"* (The collection of the Paraná fossils, purchased from D. Leo Lelong, has been brought by the traveling Naturalist in five large drawers. I had soon examined it and reported it to the Minister by a note on April 26th). Then, different entries (*e.g.*, June 12th: p. 107 of inventory or p. 126 of the document digitized—Fig. 1.1— and December 28th, p. 110 of inventory or p. 129 of the document digitized—Fig. 1.2—) recorded the preparation of some materials and their meticulous arrangement in a newly purchased cabinet for the Lelong Collection. This document certifies the purchase, acquisition, and initial organization of said collection. Furthermore, in the annual reports of the year 1886 (Filemon Posse, 1887), the acquisition of the Lelong Thévenet Collection was described by Dr. Burmeister as: *"un verdadero Tesoro para el Museo"* (a real treasure for the Museum).

Holotypes and referred materials at the MACN collected by Lelong Thévenet and Ameghino

We found holotypes and referred materials of cingulates described by Ameghino (1883a, 1883b,1885, 1886, 1889) and collected by Lelong Thévenet and Ameghino, in both the MACN-PV and MACN-A collections, respectively (Tab. 1). Following Ameghino (1889), we present the studied

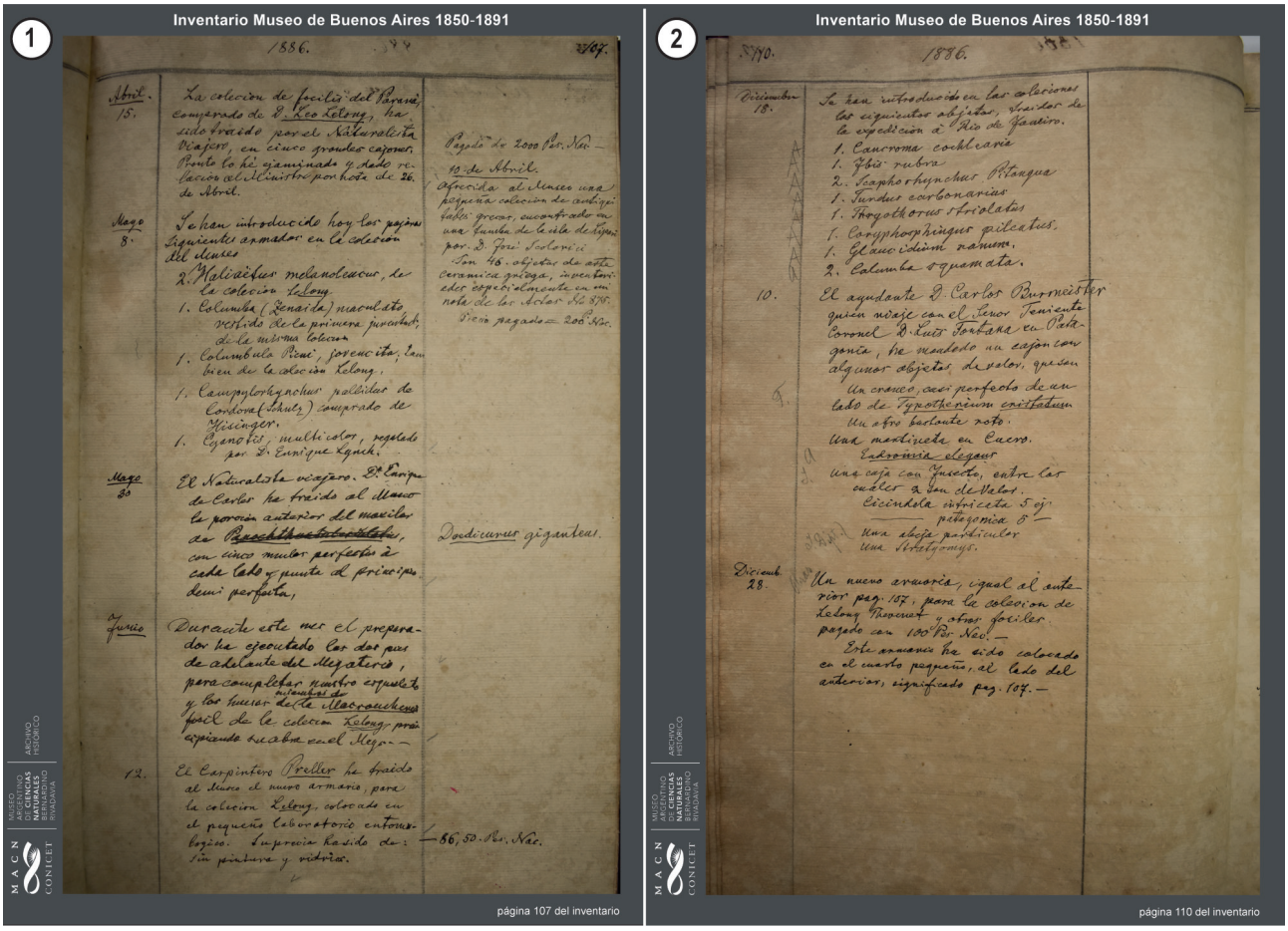


Figure 1. Details of personal notes of Burmeister in the inventory book at the **MACN. 1,** pp. 107 with details about the purchase and preparation of some materials of Lelong Thévenet Collection. **2,** pp. 110 with details of the purchase of a cabinet for the Lelong Thévenet Collection.

materials, which are separated into two main groups: Glyptodontia and Dasypoda.

SYSTEMATIC PALEONTOLOGY

Order GLYPTODONTIA Ameghino, 1889

Genus ***Palaehoplophorus*** Ameghino, 1883b

Type species. *Palaehoplophorus scalabrinii* (Ameghino, 1883b). "*Conglomerado osífero*", Late Miocene, Entre Ríos Province, Argentina.

Palaehoplophorus antiquus (Ameghino, 1883a)

Figures 2–3

[= *Glyptodon* (?) *antiquus* Ameghino, 1883a = *P. scalabrinii* Ameghino, 1883b, 1889 = *P. scalabrinii* Ameghino, 1885, 1886].

Holotype. Border osteoderm of the dorsal carapace (MAS without number, see Scillato-Yané *et al.*, 2013).

Referred material. MACN-PV 13282, fragment of the caudal tube; MACN-PV 13283, isolated osteoderms from the dorsal carapace; MACN-A 1373, isolated osteoderm from the caudal rings.

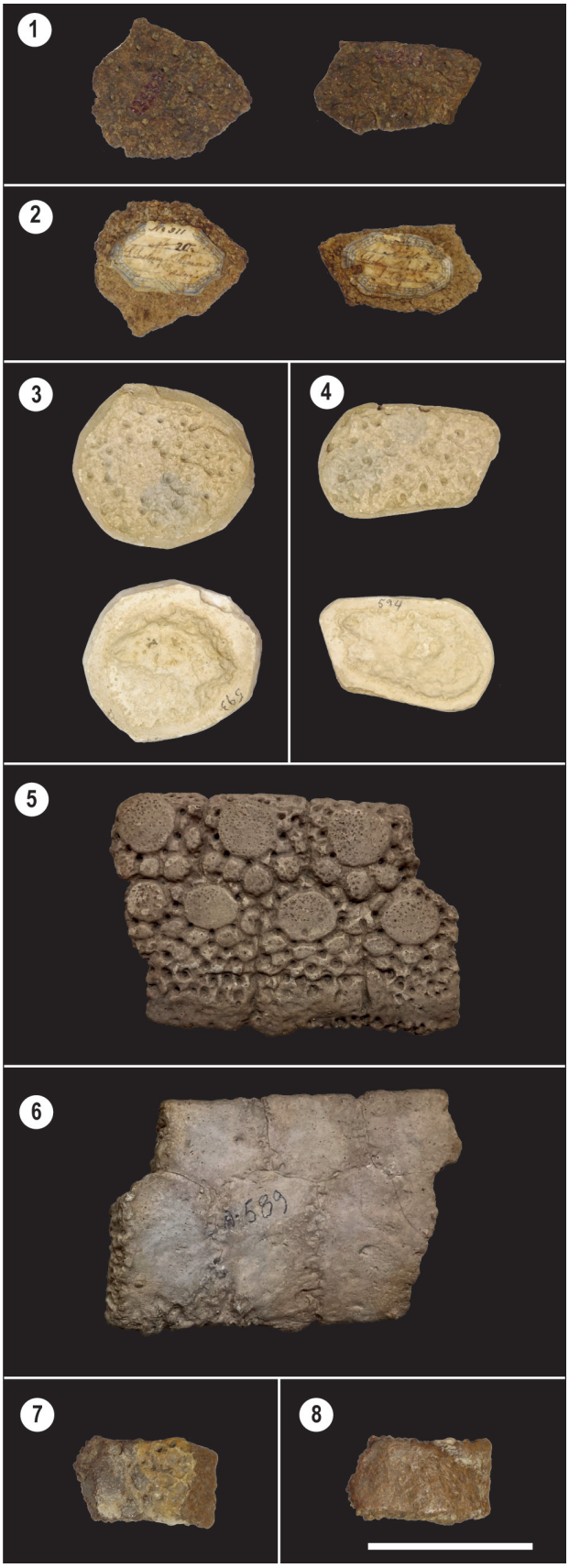
Cast of the referred material. MACN-A 589, fragment of the caudal ring (cast of MAS 159); MACN-A 593/594 isolated osteoderms/fragment of the isolated osteoderm from the dorsal carapace (casts of MACN-PV 13283); MACN-A 741, fragment of the caudal tube (cast of MACN-PV 12382).

Comments and descriptions. Ameghino (1883a) described one osteoderm from the border of the carapace and established a new species: *Glyptodon*? *antiquus*. Later, Ameghino (1883b) assigned it (together with another isolated border osteoderm and a small fragment of the

TABLE 1. Holotypes, referred materials, and casts described by Ameghino (1883a, 1883b, 1885, 1886, 1889), collected by Lelong Thévenet and Ameghino, and housed at MACN

Taxon	Plate of Ameghino (1889)	Holotype	Material Referred	Material
Palaehoplophorus antiquus	Plate 56, fig. 7		MACN-PV 13283*	Fragment of the osteoderm of the dorsal carapace
			MACN-A 594	Cast of MACN-PV 13283
	Plate 56, fig. 8		MACN-PV 13283*	Osteoderm of the dorsal carapace
			MACN-A 593	Cast of MACN-PV 13283
	Plate 58, fig. 6		MACN-A 589	Cast of MAS 159 - Fragment of the caudal ring
	Plate 65, fig. 6		MACN-PV 13282*	Fragment of the caudal tube
			MACN-A 741	Cast of MACN-PV 13282
	Plate 67, fig. 10		MACN-A 1373*	Isolated osteoderm of the caudal ring
Lomaphorus cingulatus	Plate 56, fig. 5	MACN-PV 13289		Osteoderm of the dorsal carapace
		MACN-A 592		Cast of MACN-PV 13289
Protoglyptodon primiformis	Plate 58, fig. 7		MACN-A 601	Cast of the fragment of the caudal tube
Neuryurus interundatus	Plate 56, fig. 6		MACN-PV 13285	Two osteoderm of the dorsal carapace
			MACN-A 591	Cast of the MACN-PV 13285
	Plate 62, fig. 1	MACN-A 1470–1472		Cast of the osteoderm of the dorsal carapace
Comaphorus concisus	Plate 60, figs.12–13a	MACN-A 28**		Osteoderm of the dorsal carapace
Pseudoeuryurus lelongianus	Plate 65, fig. 7	MACN-PV 13286		Osteoderm of the dorsal carapace
		MACN-A 599		Cast of the MACN-PV 13286
Chlamydotherium paranense	Plate 24, figs. 6–8		MACN-A 1469	Cast of the fragment of right mandible
	Plate 24, figs. 9–10		MACN-A 1429–1430	Cast of the isolated molariform
	Plate 67, fig. 13		MACN-A 11115	Cast of isolated movable osteoderm
	Plate 67, fig. 15		MACN-A 1570	Fragment of the isolated movable osteoderm
			MACN-A 1571	Cast of the MACN-A 1570
	Plate 67, fig. 14		MACN-A 11116	Cast of a fragment of isolated movable osteoderm
Proeuphractus limpidus	Without draw	MACN-PV 13001 (Sintype)		Isolated fixed osteoderm

*Original materials that Scillato-Yané *et al.* (2013) mentioned that were housed at MAS and were cited as 'MAS without number'.
**Original materials cited by Scillato-Yané *et al.* (2013) as 'lost within the MAS'.



caudal tube, integrated by only three incomplete osteoderms) to a new genus, *Palaehoplophorus*, and re-named the species as *P. scalabrinii* in honor of Professor Scalabrini (Ameghino, 1883b). Subsequently, he mentioned diverse osteoderms and described another one referred to the antero-marginal border (Ameghino, 1885). A year later, he described one isolated osteoderm from the border of the caudal ring and two isolated osteoderms, one of them from the lateral region of the dorsal carapace (Ameghino, 1886). Finally, Ameghino (1889) described more osteoderms from the antero, dorsal, and lateral sections of the dorsal carapace, osteoderms from the caudal rings, and two fragments of the caudal tube. In this latter publication, he added the figures of several of these materials (Ameghino, 1889, pl. 56 figs. 7–8, pl. 58 fig. 6, pl. 65 fig. 6, pl. 67 fig. 10). Concerning the type, Mones (1986) suggested that it was in the MPCNP (=MAS). Scillato-Yané *et al.* (2013) cited that it was a border osteoderm of the dorsal carapace and referred it as 'MAS, without number'. These authors did not provide any image or figure. Remarkably, when describing other materials of this species, Scillato-Yané *et al.* (2013) constantly indicated them as MAS, without number. After our research, we conclude that the original materials were in fact located in the MACN-PV (see below). Regarding the figured osteoderms of plate 56, figures 7 and 8 of Ameghino (1889), we found a fragment of an osteoderm and a complete osteoderm identical to the ones figured by Ameghino (1889), only with the difference that Ameghino represented both osteoderms integers. Each of these materials cataloged as a batch under MACN-PV 13283 (Fig. 2.1–2) has a label on the inner surface, on the fragmented osteoderm it is written: "N° 21 L. Lelong Thévenet. Paraná", whereas the complete osteoderm has two labels, one that

Figure 2. ***Palaehoplophorus antiquus*** (Ameghino 1883a), materials referred and figured by Ameghino; **1–2, MACN-PV 13283,** original osteoderms figured by Ameghino (1889, pl. 56, figs. 7–8); **1,** dorsal view; **2,** ventral view; **3, MACN-A 593,** dorsal and ventral views of the cast of the isolated osteoderm from the dorsal carapace figured by Ameghino (1889, pl. 56, fig. 8); **4, MACN-A 594,** dorsal and ventral views of the cast of the fragment of isolated osteoderm from the dorsal carapace figured by Ameghino (1889, pl. 56, fig. 7); **5–6, MACN-A 589,** cast of the fragment of the caudal rings figured by Ameghino (1889, pl. 58, fig. 6); **5,** dorsal view; **6,** ventral view; **7–8, MACN-A 1373,** original isolated osteoderm of the caudal rings figured by Ameghino (1889, pl. 67, fig. 10); **7,** dorsal view; **8,** ventral view. Scale bar= 5 cm.

says "N° 20 L. Lelong Thévenet. Paraná" and the other only with the number "311" (Fig. 2.2). Furthermore, at the MACN-A, we found two casts of these materials cataloged as MACN-A 593 (isolated osteoderm from the dorsal carapace, Fig. 2.3) and MACN-A 594 (fragment of the isolated osteoderm from the dorsal carapace, Fig. 2.4). It is likely Ameghino partially reconstrued the osteoderm of his figure 7 in plate 56, because the original is broken, the old label is complete, and the cast is identical to the original. Scillato-Yané *et al.* (2013) did not figure these materials and only mentioned that they were housed at the 'MAS, without number'. However, the original materials that we found in the MACN-PV and the casts present the exact size as the ones figured by Ameghino (1889, pl. 56, figs. 7–8), and it is even possible to distinguish some of the features that Ameghino mentioned of them. The exposed surface of the osteoderms is rough and has a circular and slightly concave main figure. In the osteoderm fragment, it could be central and in the other it is anterior. Around this main figure, two rows of rough peripheral figures can be observed, poorly defined, separated by shallow, slightly marked, moderately wide sulci and with a considerable number of large foramina, usually those that delimit the sulci. Concerning a fragment of the caudal rings of plate 58, figure 6 of Ameghino (1889), the original material (MAS 159) was described and figured by Scillato-Yané *et al.* (2013, fig. 5.3) and we found its cast cataloged as MACN-A 589 (exact in size as the one figured by Ameghino, in which it is possible to distinguish the features figured and described by Ameghino). The cast of the caudal ring fragment is composed by two rows of osteoderms (Fig. 2.5–6). The osteoderms of the anterior row are rectangular and with a sub-circular, flat, slightly smooth, and posterior main figure. It is surrounded by only one row of the peripheral figures, well-marked in the anterior section and rudimentary in the posterior border of the osteoderm. The anterior border is rough and has one accessory row of the peripheral figures. The osteoderms of

Figure 3. ***Palaehoplophorus antiquus*** (Ameghino, 1883a), materials referred and figured by Ameghino (1889, pl. 65, fig. 6); **1–3, MACN-PV 13282,** original fragment of the caudal tube; **1,** dorsal view; **2,** ventral view; **3,** left lateral view; **4–6, MACN-A 741,** cast of the fragment of the caudal tube; **4,** dorsal view; **5,** ventral view; **6,** left lateral view. Scale bar= 5 cm.

the posterior row are pentagonal, with a sub-circular, flat, slightly smooth, and posterior main figure. It is surrounded by only one row of the peripheral figures, well-marked in the anterior section and rudimentary in the posterior border of the osteoderm. The sulci of all osteoderms are well-defined, shallow, moderately wide, and with a considerable number of large foramina, usually those that delimit or mark them. The osteoderm in plate 67, figure 10 (Ameghino, 1889) corresponds to an almost complete osteoderm of the caudal ring cataloged as MACN-A 1373 (Fig. 2.7–8). Scillato-Yané *et al.* (2013) did not figure this material but mentioned that it was housed at the 'MAS, without number', adding that MACN-A 1373 was a cast. However, MACN-A 1373 is an original osteoderm of the same size as the one figured by Ameghino (1889) and it is possible to distinguish the features figured on it. The smooth and slightly punctuated exposed surface of the osteoderm has a sub-circular, flat, and posterior main figure. It is surrounded by only one row of the peripheral figures, well-marked in the anterior section and probably rudimentary in the posterior border, but is partly broken. The anterior border is rough and has one or two accessory peripheral figures. Finally, concerning a fragment of the caudal tube illustrated in plate 65, figure 6 (Ameghino, 1889), we found the original material with the number MACN-PV 13282 (Fig. 3.1–3) and a cast cataloged as MACN-A 741 (Fig. 3.4–6). Scillato-Yané *et al.* (2013) did not figure these materials. However, they cited the cast MACN-A 741 and mentioned that the original material was housed at the MAS, once again, indicating it as 'without number'. The fragment of the caudal tube and its cast (MACN-PV 13282 and MACN-A 741, respectively) corresponds to a left posterior fragment. It comprises osteoderms of different sizes with a concave or slightly concave and rough exposed surface delimited by a sulci well marked only by large and deep foramina. According to the MACN-A and MACN-PV catalogs, only MACN-A 1373 was collected by Ameghino, whereas Lelong Thévenet collected the rest. According to the MACN-PV catalog, the materials MACN-PV 13282 and MACN-PV 13283 are cataloged only as Glyptodontidae. However, according to Ameghino's handwritten and MACN-A catalogs, MACN-A 589, MACN-A 593/594, MACN-A 741, and MACN-A 1373 are indicated as *Palaehoplophorus scalabrinii*.

Genus ***Lomaphorus*** Ameghino, 1889

Type species. *Hoplophorus imperfectus* (Gervais & Ameghino, 1880). Pliocene, Buenos Aires Province, Argentina.

Lomaphorus cingulatus Ameghino, 1889
Figure 4.1–2

Holotype. MACN-PV 13289, isolated osteoderm from the dorsal carapace.
Cast type. MACN-A 592, isolated osteoderm from the dorsal carapace (cast of MACN-PV 13289).
Comments and descriptions. Ameghino (1889) established this species based on only one osteoderm from the dorsal region of the dorsal carapace collected by Lelong Thévenet (Ameghino, 1889, p. 821–822). Mones (1986) mentioned that MACN-A 592 was the cast type of this species and Scillato-Yané *et al.* (2013) added that the original material was lost but should have been at the MACN-PV. The comparison of MACN-A 592, together with the original description and illustration of Ameghino (1889, p. 821, pl. 56, fig. 5) allows us to conclude that the cast was made from the holotype. Fortunately, among the materials collected by Lelong Thévenet, we were able to find the original material, MACN-PV 13289, which has two labels, one with "N° 23 L. Lelong Thévenet. Paraná", and the other only with the number "310" (possibly corresponding to the Paraná collection). MACN-PV 13289 (Fig. 4.1) and MACN-A 592 (Fig. 4.2) are of the same size as the ones figured by Ameghino and it is possible to distinguish some of the features figured and described. The exposed surface of the osteoderm is rugose principally by the presence of many radial impressions that start in a slightly concave central region without any figures delimited by sulci. For this species, Scillato-Yané *et al.* (2013) suggested that it could belong to the genus *Trachycalyptus*. According to the MACN-PV catalog, the material MACN-PV 13289 is indicated as Glyptodontidae. However, according to Ameghino's handwritten and MACN-A catalogs, the material MACN-A 592 is registered as *Lomaphorus cingulatus*.

Genus ***Protoglyptodon*** Ameghino, 1885

Type species. *Protoglyptodon primiformis* Ameghino, 1885.

"*Conglomerado osífero*", Late Miocene, Entre Ríos Province, Argentina.

Protoglyptodon primiformis Ameghino, 1885

Figure 4.3

Holotype. Small fragment of the dorsal carapace [MAS missing, MLP-M 119 cast of the holotype, Mones (1986) and Scillato-Yané *et al.* (2013)].

Cast of referred material. MACN-A 601, fragment of caudal tube (cast of the missing material).

Comments and descriptions. Ameghino (1885) established this species from a small fragment of the dorsal carapace. Then, Ameghino (1886) added three fragments of the dorsal carapace recovered by Scalabrini and included another fragment of the dorsal carapace and an isolated osteoderm described as glyptodon indet (Ameghino, 1885, p. 135–136). Finally, Ameghino gave full descriptions of the previously mentioned materials and added a figure of a small fragment of the dorsal carapace and a caudal tube (Ameghino, 1889, pl. 54, fig. 6; pl. 58, fig. 7), stating that the former was found by Scalabrini, but the latter fragment of the caudal tube had been collected by Lelong Thévenet. Mones (1986) and Scillato-Yané *et al.* (2013) mentioned the calcotype, MLP M119, and claimed that the holotype was lost within the MAS; the fragment of the caudal tube was indicated as 'MAS without number'. Unfortunately, the

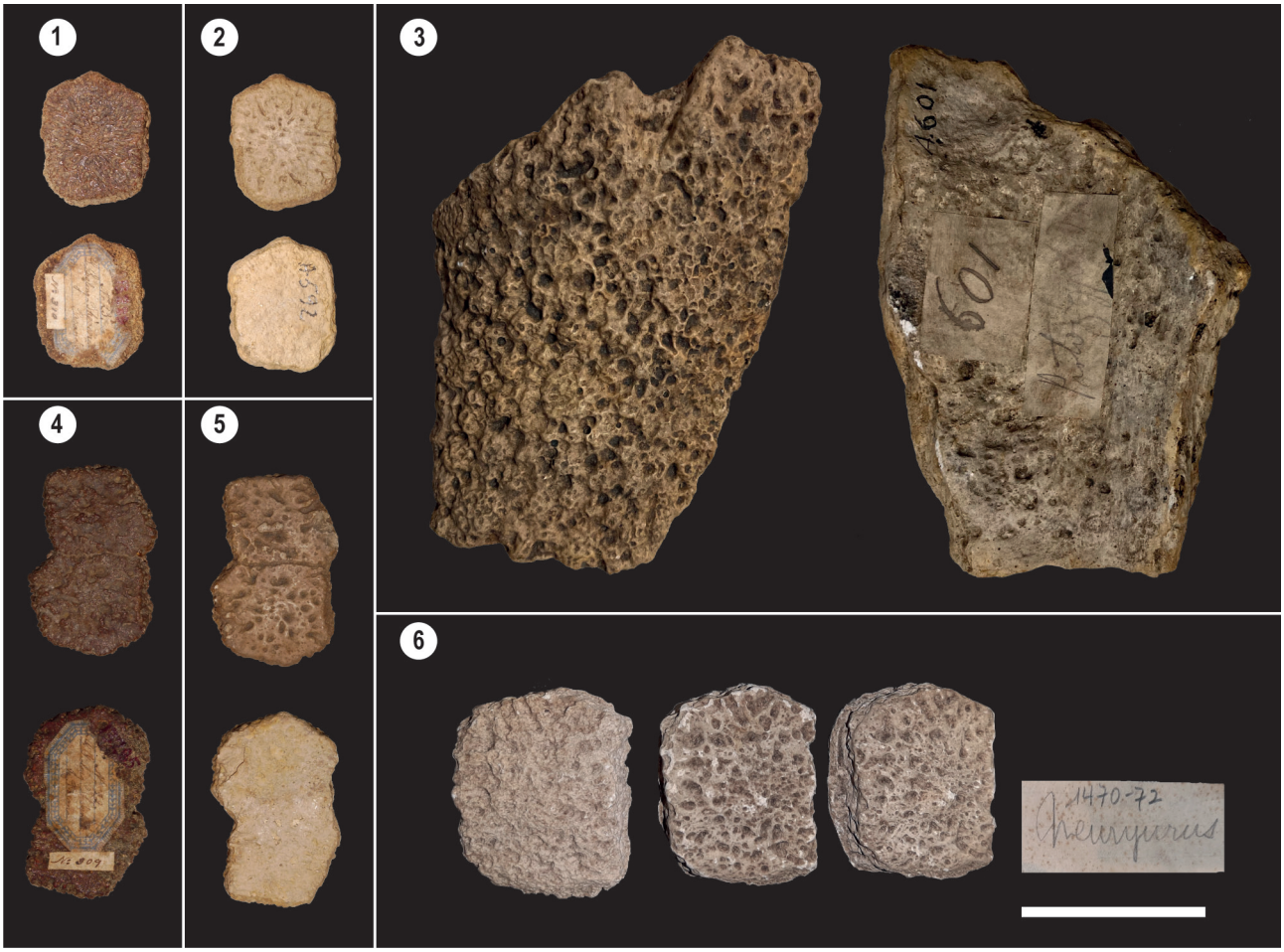


Figure 4. 1–2, *Lomaphorus cingulatus* Ameghino, 1889; **1, MACN-PV 13289,** holotype, dorsal, and ventral views of the isolated osteoderm, figured by Ameghino (1889, pl. 56, fig. 5); **2, MACN-A 592,** cast of the holotype, dorsal and ventral views; **3, *Protoglyptodon primiformis*** Ameghino, 1885, **MACN-A 601,** dorsal and ventral views of the cast of fragment of the caudal tube figured by Ameghino (1889, pl. 58, fig. 7); **4–6, *Neuryurus interundatus*** (Ameghino, 1885); **4, MACN-PV 13285,** dorsal and ventral views of the original isolated osteoderms from the dorsal carapace figured by Ameghino (1889, pl. 56, fig. 6); **5, MACN-A 591,** dorsal and ventral views of the cast of isolated osteoderms from the dorsal carapace figured by Ameghino (1889, pl. 56, fig. 6); **6, MACN-A 1470–1472,** dorsal and ventral views of the cast of the Holotype, isolated osteoderm from the dorsal carapace figured by Ameghino (1889, pl. 62, fig. 1). Scale bar= 5 cm.

original material of the latter has not been found in any of the MACN's collections yet. Nevertheless, two casts of this fragment figured by Ameghino (1889, pl. 58, fig. 7) were found, cataloged as MACN-A 601 (Fig. 4.3). Compared with the material figured (Ameghino, 1889), the casts correspond to a copy of the referred material, being the exact size of that figured by Ameghino (1889, pl. 58, fig. 7), where it is possible to distinguish some of the described features. The cast corresponds to a fragment of the anterior region of the caudal tube, and as described by Ameghino (1889), it preserved a small fragment of the anterior articular border. The exposed surface is rough and punctuated, has larger circular figures, arranged in transverse rows with smaller peripheral figures separated or delimited by wide, slightly deep indistinct sulci with large and multiple foramina. In some sectors, it is possible to observe that these figures are presented in two rows, one is closer to the main figure and smaller in size, and the other is surrounding the previous one with larger figures, perhaps due to the fusion with those of the adjacent osteoderm. These features are similar to those described by Ameghino (1889). According to Ameghino's handwritten and MACN-A catalogs, the specimen MACN-A 601 is registered as *Protoglyptodon primiformis*.

Genus ***Neuryurus*** Ameghino, 1889

Type species. *Euryurus rudis* (Gervais, 1878). "*Conglomerado osífero*", Late Miocene, Entre Ríos Province, Argentina.

Neuryurus interundatus (Ameghino, 1885)
Figure 4.4–6

1885 *Euryurus interundatus* Ameghino, p. 132

Holotype. Isolated osteoderm of the dorsal carapace (MAS?).

Cast type. MLP M229 (see Scillato-Yané *et al.*, 2013), MACN-A 1470-1472, isolated osteoderm of the dorsal carapace (cast of the missing and unnumbered holotype).

Referred material. MACN-PV 13285, two articulated osteoderm of the dorsal carapace.

Cast of the referred material. MACN-A 591, two articulated osteoderm of the dorsal carapace (cast of the MACN-PV 13285).

Comments and descriptions. Ameghino (1885) established this species based on one osteoderm from the dorsal carapace and provided a brief description. Later, Ameghino (1886) mentioned that on its internal face, it had a transverse notch that represented the vestiges of a suture, consequence of the union of two contiguous osteoderms. Therefore, the pentagonal osteoderm resulted from the fusion of two contiguous osteoderms. Finally, Ameghino (1889) added to the previous description some osteoderms from the lateral region of the dorsal carapace and their respective measurements. In this contribution, he figured in plate 56, figure 6, two osteoderms from the antero-lateral region of the dorsal carapace; in plate 62, figure 1, one osteoderm from the dorsal region of the dorsal carapace; and in plate 70, figures 5–7, three osteoderms, each from the dorsal and lateral regions of the dorsal carapace. Concerning the type, Mones (1986) mentioned the calcotype MLP M123, while Scillato-Yané *et al.* (2013) cited MLP M229 and figured it. Three casts of the osteoderm figured by Ameghino (1889, pl. 62, fig. 1) are represented by MACN-A 1470-1472 (Fig. 4.6). Compared with the original description and measurements by Ameghino (1889) and in accordance with Scillato-Yané *et al.* (2013, fig. 5.8), we can affirm that MACN-A 1470-1472 are the casts of the holotype. The exposed surface of the osteoderms is smooth, without figures, and with some slightly deep concave depressions and some small foramina without apparent order. Conversely, the original materials and the cast figured in plate 56, figure 6, are represented by MACN-PV 13285 (Fig. 4.4) and MACN-A 591 (Fig. 4.5). Both materials are the same size when compared to the ones figured by Ameghino (1889) and it is possible to distinguish some of the figured and described features. These osteoderms have two labels on the inner surface, one with "N° 22 L. Lelong Thévenet. Paraná" and the other only with the number "309". According to Ameghino (1889), all materials were found by Scalabrini, but according to the MACN and Ameghino's handwritten catalogs, MACN-PV 13285 was found by Lelong Thévenet. The material MACN-PV 13285 is cataloged only as Glyptodontidae and MACN-A 591 as *Neuryurus interundatus*, according to the MACN-PV and Ameghino's handwritten catalogs, respectively.

Genus ***Comaphorus*** Ameghino, 1886

Type species. *Comaphorus concisus* Ameghino, 1886. "*Conglomerado osífero*", Late Miocene, Entre Ríos Province, Argentina.

Comaphorus concisus Ameghino, 1886
Figure 5.1

Holotype. MACN-A 28, isolated osteoderm from the dorsal carapace.

Comments and descriptions. Ameghino (1886) established this species from one osteoderm of the dorsal carapace. Then, Ameghino (1889, pl. 60, figs. 12–13) described and figure the osteoderm. Mones (1986) suggested that the holotype was stored in the MPCNP (=MAS) and Scillato-Yané *et al.* (2013) cited that it was at the MAS, although at the time lost. However, the material MACN-A 28 has the exact size of the one figured by Ameghino (1889) and it is possible to distinguish some of the features figured and described on it (Fig. 5.1). The exposed surface of the osteoderm is smooth, with a central elevation. However, without any figures and sulci, only some slightly deep concave depressions and some small foramina without apparent order can be identified. This material is housed at the MACN-A because Ameghino collected it during his fieldtrips in October, 1884 (Ameghino, 1885, 1886, 1889; see discussion below). According to Ameghino's handwritten catalog, this material is cataloged as *Comaphorus concisus*.

Genus ***Pseudoeuryurus*** Ameghino, 1889

Type species. *Pseudoeuryurus lelongianus* Ameghino, 1889. "*Conglomerado osífero*", Late Miocene, Entre Ríos Province, Argentina.

Pseudoeuryurus lelongianus Ameghino, 1889
Figure 5.2–3

Holotype. MACN-PV 13286, isolated osteoderm from the dorsal carapace.

Cast type. MACN-A 599, isolated osteoderm from the dorsal carapace (cast of MACN-PV 13286).

Comments and descriptions. Ameghino established this species based on one osteoderm from the dorsal region of the dorsal carapace that he figured (Ameghino, 1889, pl. 65, fig. 7). The original material and its cast have been found at the MACN-PV and MACN-A collections, under numbers 13286 (Fig. 5.2) and 599 (Fig. 5.3), respectively. Both are of the same size as the ones figured by Ameghino (1889) and it is possible to distinguish some of the features figured and described on it. The exposed surface of the osteoderm is rough, with a sub-circular, central, high, and concave main figure. The area surrounding this central figure is irregular, without figures, and with some slightly deep concave depressions, concentrically arranged surrounding the main figure. Following Ameghino (1889), this material presumably corresponded to an osteoderm from the dorsal region of the dorsal carapace, something we can certify now. According to Ameghino (1889) and the catalogs at the MACN, the material was found by Lelong Thévenet. Mones (1986) referred with doubts MACN 599 as the cast of the type. The material MACN-PV 13286 was mentioned by Scillato-Yané *et al.* (2013) as the type specimen of the species. According to our study and considering the original description, measurements and material figured by Ameghino (1889), we agree with Mones (1986) and Scillato-Yané *et al.* (2013) that MACN-PV 13286 and MACN-A 599 are the holotype and its respective cast type. According to the MACN-PV catalogue, the material MACN-PV 13286 is cataloged only as Glyptodontidae. However, following the MACN-A and Ameghino's handwritten catalogs, the material MACN-A 599 is registered as *Pseudoeuryurus lelongianus*.

Order DASYPODA Ameghino, 1889

Genus ***Chlamydotherium*** Lund, 1839

Type species. *Chlamydotherium humboldtii* Lund, 1839. Pleistocene, Lagoa Santa, Minas Gerais, Brazil.

Chlamydotherium paranense Ameghino, 1883a
Figure 5.4–11

Holotype. Isolated fixed osteoderm (lost?).

Referred materials. MACN-A 1570, fragment of the isolated movable osteoderm.

Cast of the referred materials. MACN-A 1429/1430, isolated molariform; MACN-A 1469, fragment of right

Figure 5. 1, ***Comaphorus concisus*** Ameghino, 1886, **MACN-A 28,** Holotype, dorsal, ventral, and lateral views of the isolated osteoderm figured by Ameghino (1889, pl. 60, figs. 12–13a); **2–3,** ***Pseudoeuryurus lelongianus*** Ameghino, 1889, figured by Ameghino (1889, pl. 65, fig. 7); **2, MACN-PV 13286,** Holotype, dorsal and ventral views of the isolated osteoderm; **3, MACN-A 599,** cast of the Holotype, dorsal and ventral views. **4–11,** ***Chlamydotherium paranense*** Ameghino, 1883a; **4, MACN-A 1469,** cast of the fragment of right mandible figured by Ameghino (1889, pl. 24, figs. 6–8), labial, lingual, and occlusal views; **5, MACN-A 1429–1430,** cast of the isolated molariform figured by Ameghino (1889, pl. 24, figs. 9–10), labial, lingual, and occlusal views; **6, MACN-A 11115,** cast of the isolated movable osteoderm figured by Ameghino (1889, pl. 67, fig. 13); **7,** personal note associated with **MACN-A 11115**; **8, MACN-A 1570,** original fragment of the isolated movable osteoderm figured by Ameghino? (1889, pl. 67, fig. 15), dorsal view; **9, MACN-A 1571,** cast of the fragment of the isolated movable osteoderm figured by Ameghino? (1889, pl. 67, fig. 15), dorsal view; **10, MACN-A 11116,** cast of the isolated movable osteoderm probably figured by Ameghino (1889, pl. 67, fig. 14); **11,** personal note associated with **MACN-A 11116**. Scale bar= 5 cm.

mandible; MACN-A 1571, fragment of the isolated movable osteoderm (cast of MACN-A 1570); MACN-A 11115, isolated movable osteoderm; MACN-A 11116, fragment of the isolated movable osteoderm.

Comments and descriptions. Ameghino (1883a) established this species based on one pentagonal osteoderm from the dorsal carapace. Then, he added seven osteoderms and expanded the original diagnosis (Ameghino, 1883b).

Posteriorly, he added an isolated molariform and a mandibular fragment with four molariforms among the materials he collected (Ameghino, 1885) and a year later, another eight osteoderms (Ameghino, 1886). Finally, Ameghino described in detail all these materials, figured them (Ameghino, 1889, pl. 24, figs. 6–10; pl. 67, figs. 13–15), and explained that the remains were collected by Scalabrini, by him, and other collectors. Regarding the type, Mones (1986) suggested that it was lost in the Instituto Nacional Superior del Profesorado (Paraná, Entre Ríos Province). Casts of other of these materials are represented by MACN-A 1429–1430, MACN-A 1469, MACN-A 1571, and MACN-A 11115–11116. Compared with the original description of Ameghino (1883a), none was a cast of the type, but there are casts of the materials referred to and figured by Ameghino (1889). The casts cataloged as MACN-A 1469 (Fig. 5.4) and MACN-A 1429–1430 (Fig. 5.5) are figured by Ameghino (1889, pl. 24, figs. 6–8 and figs. 9–10, respectively) and correspond to referred materials of the species. The mandibular fragment corresponds to a central fragment of the right ramus with five molariforms, posteriorly broken at the same level as the beginning of the ascending ramus. The size of the molariforms decreases in an antero-posterior direction and exhibit the same morphology; all of them are elliptical, bi-lobed with the labial groove more pronounced than the lingual one. With respect to the specimen MACN-A 11115 (Fig. 5.6), it is a cast of the isolated movable osteoderm figured by Ameghino (1889, pl. 67, fig. 13). The exposed surface is slightly rough, with a wide longitudinal central elevation, anteriorly depressed, confluent with the marginal elevation, but not reaching to the posterior border and without lateral projections. The intermediate portion is concave and wide, similar in size to the marginal elevation, without lateral margins only with lateral foramina at the lateral border. This material had a personal note that wrote: *"Chlamydotherium paranense, Plancha LXVII Fig. 13 de mamiferos fósiles"* (*Chlamydotherium paranense*, plate 67 fig. 12 of fossil mammals) (Fig. 5.7). Adding to these materials, we found an original fragment of the isolated movable osteoderm and its cast (MACN-A 1570–1571 respectively, Fig. 5.8–9) that probably correspond to the one figured in Ameghino (1889, pl. 67, fig. 15). Query arise because whereas it is complete in Ameghino's illustration, both the original osteoderm and its cast are fragmented, similarly to what was presented previously (see *Palaehoplophorus antiquus*). We found another cast, MACN-A 11116 (Fig. 5.10), fragment of the isolated movable osteoderm that probably corresponds to that figured by Ameghino (1889, pl. 67, fig. 14). This material had a personal note that wrote: *"Chlamydotherium typum, Plancha LXVII Fig. 14 mamiferos fósiles"* (*Chlamydotherium typum*, pl. 67 fig. 14 fossil mammals) (Fig. 5.11). According to the MACN-A and Ameghino's handwritten catalogs, MACN-A 1429/1430, MACN-A 1469, MACN-A 1570, MACN-A 1571, and MACN-A 11115 are identified as *Chlamydotherium paranense*. However, according to the MACN-A catalog, the material MACN-A 11116 was indicated as *Chlamydotherium typum*.

Genus ***Proeuphractus*** Ameghino, 1886

Type species. *Proeuphractus limpidus* Ameghino, 1886. "*Conglomerado osífero*", Late Miocene, Entre Ríos Province, Argentina.

Proeuphractus limpidus Ameghino, 1886
Figure 6.1–2

Syntype. MACN-PV 13001, isolated fixed osteoderm and MLP ? (lost), isolated movable osteoderms.

Comments and descriptions. Ameghino (1886) erected this species from one isolated fixed osteoderm, collected by Lelong Thévenet, and one movable osteoderm collected by himself. He then described these osteoderms, but, unfortunately, he did not illustrate them (Ameghino, 1889,

Figure 6. ***Proeuphractus limpidus*** Ameghino, 1886, **MACN-PV 13001,** isolated fixed osteoderm**,** Syntype; **1,** dorsal view; **2,** ventral view; **3,** personal note associated with **MACN-PV 13001**; **4–5,** label associated with **MACN-PV 13001**. Scale bar= 2 cm.

p. 869–870). Afterward, Ameghino mentioned that the materials figured by Lydekker purportedly stored at the MLP (1894, pl. 33, 7–8) were the syntypes (Ameghino, 1920 in Torcelli, 1920, p. 881). This apparently led other authors to consider the syntypes to be lost at the MLP (Mones, 1986; Scillato-Yané *et al.,* 2013). However, as part of the Lelong Thévenet's Collection, the fixed osteoderm should have been stored at the MACN and the movable osteoderm as part of Ameghino's collection at the MLP (Fernicola, 2011a). We therefore search for the former material within the collections at this institution (MACN-Pv, MACN-A), successfully finding the fixed osteoderm under MACN PV 13001 (Fig. 6) with two labels, one with "*Proeuphractus limpidus*" written by Ameghino himself (Fig. 6.3). The other with several legends such as 'Not type', 'Lelong Collection', '13001', and with a painted red spot (Fig. 6.4) and on its reverse only 'Cotype' (Fig. 6.5), with different people's handwritings. The material has similar measurements and anatomical characteristics and was collected by Lelong Thévenet, which allows us assign it as part of the syntype. The exposed surface of the fixed osteoderm is smooth, with a principal lageniform figure that occupies the posterior three quarts of the exposed surface of the osteoderm. The posterior portion of the principal figure is strongly elevated. Surrounding this principal figure, there are four anterior peripheral figures (one of them is very small) and three lateral peripheral figures (two in the right lateral and one in the left lateral) delimited by marked sulci. All these peripheral figures are convex. The piliferous system is developed, composed of lateral and posterior foramina, and is positioned between the posterior border of the lateral left peripheral figure and the posterior border of the principal figure. According to the MACN-PV catalog, MACN-PV 13001 is registered as *Proeuphractus limpidus*.

Casts of the holotypes described by Ameghino and collected by Scalabrini at the MACN

We also found at the MACN-A, casts of the holotype of three other taxa described by Ameghino (1883a, 1885, 1889) and collected by Scalabrini (Tab. 2): *Hoplophorus paranensis* (Ameghino, 1883a), *Palaehoplophorus pressulus* (Ameghino, 1885), and *Hoplophorus verus* (Ameghino, 1889), all figured in Ameghino (1889). Concerning *Hoplophorus paranensis* Ameghino (1883a), it was described based on a fragment of the dorsal region of the carapace. Later, Ameghino (1889) described this material in more detail, along with another fragment from near the border of the dorsal carapace and an isolated osteoderm from the dorsal region. The first fragment, the holotype, was figured by Ameghino (1889, pl. 64, fig. 4). Ameghino (1889) mentioned that these materials were founded by Scalabrini and were housed at the Museo Provincial de Entre Ríos. A cast of the material figured in Ameghino (1889) is represented by MACN-A 1231 and labelled "N° A 12 Am" (Fig. 7.1–2). Compared with the original description in Ameghino (1883a), the given measurements, and the material figured in Ameghino (1889), we can establish that this cast corresponds to the cast of the holotype. Another cast of this species would be MLP M-118, mentioned by Mones (1986). Regarding *Palaehoplophorus pressulus*, Ameghino (1885) described this new species based on two fragments of different specimens, one of them was a dorsal carapace and the other were caudal rings. Subsequently, Ameghino (1889) re-described the same materials, figured the fragment of the dorsal carapace (Ameghino, 1889, pl. 69, fig. 16), and specified that these materials were found by Scalabrini and were housed at the Museo Provincial de Entre Rios. Castellanos (1940), based on these materials, created the genus *Chlamyphractus* and established *C. pressulus* as

TABLE 2. Casts housed at the MACN-A of the holotypes described by Ameghino (1883a, 1885, 1889), collected by Scalabrini, and housed at MAS

Taxon	Plate of Ameghino (1889)	Holotype	Cast of the holotype	Material
Hoplophorus paranensis	Plate 64, fig. 4	MAS?	MACN-A 1231	Cast of the small fragment of the dorsal carapace
Palaehoplophorus pressulus	Plate 69, fig. 16	MAS W/N	MACN-A 1279-1280	Cast of the small fragment of the dorsal carapace
Hoplophorus verus	Plate 64, fig. 15	MAS W/N	MACN A 1610-1612	Cast of the isolated osteoderm of the dorsal carapace

the type species. A cast of the material figured by Ameghino (1889, pl. 69, fig. 16) is represented by MACN-A 1279-1280 (Fig. 7.3–6). Compared with the original description of Ameghino (1883a) and the material figured by the author (1889, pl. 69, fig. 16), this cast corresponds to one specimen of the type series. Another cast of the material would be MLP M-121 which was mentioned by Mones (1986). Finally, *Hoplophorus verus* Ameghino, 1889 was erected based on one osteoderm from the dorsal region of the dorsal carapace (Ameghino, 1889, pl. 69, fig. 15). A cast of this material is represented by MACN-A 1610–1612 (Fig. 7.7–8). Compared with the original description of Ameghino (1883a) and the material figured in Ameghino (1889), this cast corresponds to a cast of the type. According to the catalog of MACN-A, the original material was collected by Scalabrini. Another cast of the type would be MLP M-124, which was mentioned by Mones (1986). This species was proposed as "*nomen dubium*" by Zurita (2007).

DISCUSSION

The dispute over the Lelong Thévenet Collection is possible to analyze as another chapter in the long confrontation between Ameghino and Burmeister that began in the 1870s, the most outstanding point of which was the dispute over the head of Museo Nacional when it was nationalized in 1884 (Podgorny & Lopes, 2008).

It is not difficult to infer that the purchase of the specimens collected by the Lelong Thévenet family at Burmeister's request would allow him to compete with the studies that Ameghino (1883a, 1883b, 1885) started concerning the fauna of Paraná (Entre Rios Province), based on the specimens collected by Scalabrini. Unfortunately, Burmeister did not study any of the specimens of cingulates acquired by the Museo Nacional in 1886 (Fig. 1). This collection, as well as the analysis of Ameghino on these

Figure 7. 1–2, *Hoplophorus paranensis* Ameghino, 1883a, **MACN-A 1231,** small fragment of dorsal carapace, cast of the holotype figured by Ameghino (1889, pl. 64, fig. 4); **1,** dorsal view; **2,** ventral view; **3–6, *Palaehoplophorus pressulus*** Ameghino, 1885, **MACN-A 1279–1280,** small fragment of the dorsal carapace, cast of the Holotype figured by Ameghino (1889, pl. 69, fig. 16); **3, 5,** dorsal view; **4, 6,** ventral view; **7–8, *Hoplophorus verus*** Ameghino, 1889, **MACN-A 1610–1612,** isolated osteoderm, cast of the holotype figured by Ameghino (1889, pl. 69, fig. 15); **7,** dorsal view; **8,** ventral view. Scale bar= 5 cm.

sites, were quickly put aside by the irruption of the discovery of the extinct fauna of Patagonia. In 1886, Ameghino received a called by Moreno, Director of the MLP. Both quickly reached an agreement that concluded with the purchase of Ameghino's collection, the incorporation of his brother Carlos as a traveling naturalist of the MLP, and himself as "*Secretario sub director*" (sub-director secretary) (Podgorny & Lopes, 2008; Fernicola, 2011a, 2011b). Among the first actions they carried out together was the design of the first geological-paleontological field trip, led by Carlos Ameghino, to the fossil deposits of the Santa Cruz Province (Fernicola, 2011a, 2011b). On the other hand, Burmeister commissioned his son, Carlos Burmeister, on an expedition to Santa Cruz Province, with the same purposes (Podgorny, 2002; Fernicola, 2011b). The result of this dispute is well-known; while Carlos Burmeister's findings were scarce, those of Carlos Ameghino accounted for more than 2000 pieces of fossil vertebrates. From these, Ameghino (1887) recognized 122 taxa, of which 110 were new species. This led Ameghino (1889) to define the concept of "*Formación Santacruceña*" and "*Piso Santacruceño*" ("Santacrucian Stage") (Fernicola, 2011a, 2011b; Fernicola *et al.*, 2014, 2019).

The 'forgotten' cingulate specimens from Entre Ríos Province, even though they were reported in the museum's inventory, had a dark fate in the paleontological collections of the Museo Nacional. According to the information of the different data entry books of the MACN-PV collection, the specimens of the Lelong Thévenet Collection were registered in, at least, two moments: 1) in 1886, perhaps by the same director of the museum at that moment, Dr. Burmeister; and 2) between 1940–1941, by Alejandro Federico Bordas (??–19??), maybe with Noemi Violeta Cattoi (1911–1965). In the case of the glyptodonts, most of them were referred to the Glyptodontidae and none had any nomenclatural information (see above for each case). In the case of the dasipodids, there were specific taxonomic assignments and, in some cases, nomenclatural acts, as is the case of *Proeuphractus limpidus* (MACN-PV 13001), which was designated as 'Type' or 'Cotype'. It is possible that this difference in the taxonomic information is due to the fact that Bordas focused his studies on the dasipodids of Argentina (Bordas, 1938). Unfortunately, the specimen referred as MACN-PV 13001 was not considered as the type for a long time, even though it was indicated as such on the label that accompanied it (Fig. 6), as well as stated in the catalogs of the MACN-PV. To date, we do not have precise information about who wrote 'not type' on the label, although it is possible that it was Scillato-Yané (1982) who, in his PhD thesis, considered that the type specimen was lost at the MLP (see *Proephractus limpidus*).

Regarding *Comaphorus concisus*, and according to the historical data available, its type specimen should be housed in the MLP because it was part of the Ameghino Collection at the time that it was sold to this institution (Farro, 2008, 2009; Fernicola, 2011a). However, as it occurred with other specimens that were part of this matter, they are currently found deposited at the MACN as part of the MACN-A. The situation of *Comaphorus concisus* is identical to that described for several specimens collected by Carlos Ameghino in 1887 in Santa Cruz Province, which were assumed to be housed at the MLP. However, these were appropriated by F. Ameghino in the context of his dispute with Moreno (Fernicola, 2011a; Fernández *et al.*, 2018, 2019; Olivetto *et al.*, 2022), entering MACN when the Ameghino Collection was purchased by the national state.

The figures in the Atlas of Ameghino (1889) of specimens from the Lelong Thévenet Collection, acquired by the Museo Nacional in 1886, suggests that they could have been made from their casts instead of the original specimens. Supporting this idea is the fact that Ameghino (1889) only acknowledged Burmeister for giving him access to the Museum's library, without mentioning the collections. The distance between both naturalists suggests the Director of the Museo Nacional did not offer Ameghino the specimens recently purchased by the institution for his studies. In this particular situation are the holotypes of the species erected by Ameghino in 1889: *Pseudoeuryurus lelongianus* (MACN-PV 13286) and *Lomaphorus cingulatus* (MACN-PV 13289); and the referred materials to *Neuryurus interundatus* (MACN-PV 13285) and *Paleohoplophorus antiquus* (MACN-PV 13282 and MACN-PV 13283). It is important to remark that the casts of these materials (at the MACN-A collection) are of excellent quality and identical to the originals. It is very probable that Ameghino, during his trip in October of 1884, made these extraordinary casts on which the figures of his Atlas were based.

CONCLUSIONS

It was historically known that the Lelong Thévenet Collection was acquired in 1886 by the *Museo Nacional* (nowadays MACN). However, the exact composition of the materials that comprised it was unknown. Its purchase, managed by the then museum director, German Burmeister, is documented in the archives of the museum between February and April, 1886. Even though the purchase was made between those dates, the materials that constitute the Lelong Thévenet Collection were formally entered at different instances in the MACN records. Several osteoderms of cingulates purchased in 1886 from the Lelong Thévenet family turned out to be figured in Ameghino's Atlas of 1889. Thus, some of these materials have been recognized as the type specimens or referred materials of these armored mammals, out of which we identified 10 original materials, four corresponding to holotypes and six to referred materials. Added to these, 17 casts were identified, six belonging to holotypes and 11 to materials referred and figured by Ameghino (1889). We think it is very likely that the absence of taxonomic information in the materials, plus their entry at different historical moments, has contributed to the idea that the reference specimens were lost. It is highly possible that this situation could be extrapolated to other taxonomic groups of the Lelong Thévenet Collection.

Finally, for all the reasons above, we emphasize how essential it is to carry out an analysis of the historical course of the collections, tracking, identifying and registering those materials that are apparently lost. Only then it will be possible to make any taxonomic decisions and assignations, as it is essential to have the type materials or at least the corresponding figures provided by the author of each taxon.

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CURATION AND CATALOGING OF THE "OLD COLLECTIONS" OF FOSSIL VERTEBRATES OF THE MUSEO DE LA PLATA (1884–1902): THE CASE OF NESODONTINAE (MAMMALIA, NOTOUNGULATA, TOXODONTIDAE) FROM THE SANTA CRUZ FORMATION

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Abstract. The process of organizing early collections for the simple sake of storing and retrieving information—for example, assigning identifying numbers to specimens, recording those numbers in a catalog, and, more recently, adding that information to a computerized database—has long been central to museum collections management. In this sense, catalog numbers are vital when specimens are used for research. Particularly the early fossil vertebrate collections ("Old Collections") of the Museo de La Plata, Argentina, incorporated in the last decades of the 19th Century and the beginning of the 20th century (that is, between 1884 and 1902) to this institution are considered foundational. They hold approximately 35,000 specimens that show diverse and varied ways in the curatorial and cataloging procedures carried out throughout time. In this contribution, we selected the notoungulate mammals Nesodontinae (Toxodontidae) from the Santa Cruz Formation (Early–Middle Miocene) housed in the Vertebrate Paleontology collection, as a sample study. The reasons to study this group are: (1) its scientific importance, as it was one of the best studied between 1887 and 1894; (2) it includes some of the first vertebrates incorporated into the Museo de La Plata in 1884; and (3) there are a large number of specimens in the collection. More than 780 specimens were reviewed, with 84 type specimens registered, several previously reported as lost.

Key words. Toxodontia. *Nesodon. Adinotherium*. Santacrucian. Old Collections. Management.

Resumen. CURACIÓN Y CATALOGACIÓN DE LAS "COLECCIONES ANTIGUAS" DE VERTEBRADOS FÓSILES DEL MUSEO DE LA PLATA (1884–1902): EL CASO DE LOS NESODONTINAE (MAMMALIA, NOTOUNGULATA, TOXODONTIDAE) DE LA FORMACIÓN SANTA CRUZ. El proceso de organizar las colecciones antiguas por el simple hecho de almacenar y recuperar información—por ejemplo, identificar y asignar números de catálogo a los especímenes, registrar esos números en catálogos y, más recientemente, incorporar esa información a bases de datos digitales—ha sido durante mucho tiempo tema central de la gestión de las colecciones de un museo. Particularmente las primeras colecciones de vertebrados fósiles ingresadas al Museo de La Plata ("Colecciones Antiguas") que fueron incorporadas en las últimas décadas del siglo XIX y comienzos del siglo XX (esto es, entre 1884 y 1902) son consideradas fundacionales en esa institución. Cuentan con aproximadamente 35.000 especímenes y muestran una gran variedad de procedimientos curatoriales y de catalogación realizados a través del tiempo. En esta contribución, hemos seleccionado como caso de estudio los mamíferos notoungulados Nesodontinae (Toxodontidae) provenientes de la Formación Santa Cruz (Mioceno Temprano–Medio) por las siguientes razones: (1) su importancia científica, ya que este grupo fue uno de los mejor estudiados entre 1887 y 1894; (2) fueron uno de los primeros vertebrados fósiles incorporados al Museo de La Plata en 1884; (3) incluyen un gran número de especímenes dentro de la colección. Se revisaron más de 780 especímenes y se registraron 84 especímenes tipo, varios de ellos previamente reportados como perdidos.

Palabras clave. Toxodontia. *Nesodon, Adinotherium.* Santacrucense. Viejas Colecciones. Gestión.

THE FOSSIL vertebrate collections incorporated into the Museo de La Plata (MLP) between 1884 and 1902 hold approximately 35,000 specimens. These collections include reptiles, birds, and terrestrial and marine mammals from the Argentine Pampean region and Patagonia collected, exchanged, or purchased by Francisco P. Moreno (1852–1919; Fig. 1.1) before the creation of the MLP, and those collected by the first explorations to Patagonia organized by the MLP. They also include significant originals and casts of Pampean mammals purchased from Florentino Ameghino

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(1854–1911; Fig. 1.3), and originals provided by the Swiss naturalist Santiago Roth (1850–1924; Fig. 1.9).

The terrestrial fossil mammals from Patagonia are considered the foundation stone of what Rosendo Pascual (1925–2012), Head of the *División Paleontología Vertebrados* (DPV) of the MLP between 1957–2007, informally termed "Old collections" ("*Viejas Colecciones*" *in schedula* in the DPV-Record Book N° 3, p. 92–93) in 1958. Later, the term was used to refer also to other groups (whales, birds, dinosaurs) that are part of the early fossil vertebrate collections from Patagonia and Pampean region housed in the MLP-PV (Museo de la Plata-Paleontología Vertebrados) collection.

Particularly important are the terrestrial mammals (Metatheria, Xenarthra, Notoungulata, Astrapotheria, Litopterna, Rodentia, and Primates) from the Early–Middle Miocene Santa Cruz Formation (SCF). This is one of the most widespread continental formations in South America, cropping out virtually all along the Santa Cruz Province in Argentina (Vizcaíno *et al.*, 2012a, 2022; Fernicola *et al.*, 2019; Cuitiño *et al.*, 2019, 2021), and its fossils represent the best record for interpreting the biological diversity of mammals in the southern part of South America before the Great American Biotic Interchange (see Vizcaíno *et al.*, 2012b). They were crucial for understanding and setting the succession of Cenozoic faunas from Patagonia (Ameghino, 1906) and constituted the basis for the establishment of the Santacrucian South American Land Mammal Age (SALMA) (Pascual *et al.*, 1965; Kay *et al.*, 2021).

The first fossil mammals of the SCF were collected from the exposures along the Río Santa Cruz (RSC) valley by F. P. Moreno during 1876–1877 and by Carlos Ameghino (1865–1936; Fig. 1.2) in 1887. They consisted of a large number of

Figure 1. Relevant scientists that participated as researchers, collectors, and curators of the fossil vertebrate collection from **SCF** at the **MLP**. **1,** Francisco P. Moreno, from Archivo Histórico del Museo de La Plata; **2,** Carlos Ameghino from https://alchetron.com/Carlos-Ameghino; **3,** Florentino Ameghino, from https://www.wikiwand.com/es/ Florentino_Ameghino; **4,** Carlos G. Burmeister, from Berg (1985); **5,** Alcides Mercerat, from Vignati (1935); **6,** Santiago Pozzi, from Laza (2019); **7,** Clemente Onelli, from Archivo Histórico del Museo de La Plata; **8,** Richard Lydekker, from Archivo Histórico del Museo de La Plata; **9,** Santiago Roth, from Archivo Histórico del Museo de La Plata.

specimens (*ca.* 3,500) and became the kernel of the SCF vertebrates in the MLP-PV collection.

Among them, the notoungulates, including the groups Toxodontia (Toxodontidae and Homalodotheriidae) and Typotheria (Interatheriidae and Hegetotheriidae), are very common and include skulls and mandibles excellently preserved, isolated teeth, and postcranial elements. In the last part of the 19th century, one of the better-studied groups of the MLP-PV collection was Nesodontinae (Toxodontidae), holding approximately more than 80 type specimens studied by Moreno (1882), Ameghino (1887a, 1887b; 1889), Mercerat (1891b), Lydekker (1895), and Roth (1899).

Until 1925, the ways in which the "Old Collections" and the specimens were labeled and cataloged varied greatly according the criteria of the persons in charge of the collections, in some cases, following personal rather than institutional styles. Unfortunately, a formal record catalog that allows to easily understan the early customs or codes for cataloging was not always kept.

This contribution intends to clarify the curatorial and cataloging procedures used over time on the Nesodontinae (Notoungulata, Toxodontidae) specimens from the "Old Collections" of the MLP-PV. For our purposes, this group represents a clear example to identify different curatorial transactions and decisions on the specimens and the timing of the different cataloging systems used in the early fossil vertebrate collections of the MLP-PV.

BACKGROUND ON THE NATURE, ORIGIN, AND FIRST STUDIES OF THE TOXODONTIDS FROM THE SCF

The fossiliferous exposures of the RSC were explored during 1876–1877 by Moreno (1879), who collected few, but remarkable, fossil mammals of Santacrucian Age. In 1877, during an expedition to Lago Argentino, F. P. Moreno and Carlos M. Moyano (1854–1910) collected the first nesodontines along the valley of the RSC (Moreno, 1879) (Fig. 2). Moreno (1882, p. 23) mentioned the discovery of *Nesodon imbricatus* remains in the RSC in the same place where the skull of an astrapothere had been unearthed, his "*Mesembriotherium brocae*", *nomen illegitimun*. Actually, this specimen is the holotype of *Astrapotherium patagonicum* Burmeister, 1879 (MLP-PV 12-119, Fig. 3; Mercerat, 1891a). In the same place, he also collected two mandibles and isolated teeth of a toxodontid that he called "*Toxodon patagonenes*", *nomen nudum* (Mercerat, 1891, pp. 417–418, 444), MLP-PV 12-43 (Fig. 4.1) and MLP-PV 68-IV-25-10 (Fig. 4.2), syntypes of *Nesotherium patagonense* Mercerat, 1891.

In 1884, F. P. Moreno, who had become the founder and first director of the MLP, donated to the museum the collection he had made in 1874 and 1876–1877 in the Santa Cruz territory and other purchased collections (Vizcaíno *et al.*, 2013). In July 1886, F. Ameghino (1854–1911; Fig. 1.3) became the "*Secretario Subdirector*" (or Assistant Director) of the MLP. Soon after, his brother C. Ameghino (Fig. 1.2) was

Figure 2. Map of the **RSC** with the itinerary and localities of the expedition of F. P. Moreno, 1876–1877, modified from Moreno (1879). The **RSC** originates in the Lago Argentino and flows through a deeply incised valley, stretching 230 km from west to east across the continent.

Figure 3. ***Astrapotherium patagonicum*** Burmeister, 1879, holotype **MLP-PV 12-119**.

hired as "*Ayudante Preparador de Paleontología*" (Assistant Preparator of Paleontology) and "*Naturalista Viajero*" (Travelling Naturalist) (see Fernicola, 2011a, 2011b; Vizcaíno, 2011; Fernicola *et al.*, 2014). In the same year, the MLP started a field research and a collecting program. In January 1887, F. P. Moreno commissioned C. Ameghino to the Santa Cruz territory to follow up on his earlier discoveries (Farro, 2009; Vizcaíno, 2010; Fernicola, 2011a, 2011b; Vizcaíno *et al.*, 2012a, 2012b, 2013). The maps produced by the British Vice-Admiral Robert Fitz Roy (1805–1865), captain of HMS Beagle during Charles Darwin's famous voyage, extended and improved by the expeditions of F. P. Moreno in1876–1877, served as a guide for C. Ameghino's expedition to the SCF in the RSC, beginning in January 1887 and returning to La Plata in September 1887 (F. Ameghino, 1887a; C. Ameghino, 1890). Data published by F. Ameghino (1887a, 1887b) and C. Ameghino (1890) indicated that the specimens were collected in three localities along the RSC, between 90 and 200 km west of its mouth, and possibly a fourth locality at about 50 km further southwest (see Fernicola *et al.*, 2014 for details on these localities).

Approximately 2,500 fossil vertebrate specimens from the SCF (number estimated from crossing data of the "*Inventario de las existencias del Museo de La Plata-Inventario de la Sección Paleontológica*", DPV internal inventory reports of S. Roth in 1902; Book Catalog of Fossil Vertebrates N° 1 and N° 2 —see below—, and Archival card catalog) were collected in this expedition to the RSC and housed in the MLP-PV. The fossils were described by Ameghino (1887a, 1887b), who named more than 120 new species of extinct mammals. Among them, F. Ameghino erected 16 species of toxodontid nesodontines (Ameghino, 1887a; Tab. 1), but the descriptions of these species were published later (Ameghino, 1887b). Then, F. Ameghino published the data on which he termed the *Formación Santacruceña* or *Piso Santacruceño* (Ameghino, 1889).

In 1888, F. P. Moreno commissioned the Italians Santiago Pozzi (1849–1929; Fig. 1.6) and Clemente Onelli (1864–1924; Fig. 1.7), with the assistants Juan Ivovich and Francisco Larrumbe, to undertake a second expedition to the RSC (Moreno, 1890; Farro, 2008). Approximately 2,900 fossil vertebrate specimens (an estimated number obtained from crossing data of the "*Inventario de las existencias del*

Figure 4. Toxodontids collected by F. P. Moreno in 1876–1877 from **RSC**: "***Toxodon patagonenes***" (*nomen nudum*), ***Nesotherium patagonense*** Mercerat, 1891, Syntypes **1, MLP-PV 68-IV-25-10**, right palate with P4–M3 broken and **2, MLP-PV 12-43**, left palate with P4–M3 (probably both belong to the same individual); **3,** F. Ameghino handwriting label (taxonomic identification): "***Protoxodon patagonensis***"; **4,** F. Ameghino handwriting label (coded): "I-S-(3)"; **5,** A. Mercerat handwriting label (taxonomic identification): "***Trematherium patagonensis***" (*nomen nudum*, note that *Trema* was amended by *Neso* in blue ink). The same three handwriting labels are adhered on both specimens; **6, MLP-PV 12-43** figured by Ameghino (1889, pl. XVII, fig. 6) as ***Protoxodon sulivani*** Owen (***Nesotherium patagonense*** Mercerat, 1891); **7–8, MLP-PV 12-984** ***Nesodon imbricatus***, right mandibular fragment with symphysis and i2, **7,** in labial view, and **8,** in occlusal view. Scale bar= 1 cm.

Museo de La Plata - Inventario de la Sección Paleontológica", DPV internal inventory reports of S. Roth in 1902; Book Catalog of Fossil Vertebrates N° 1 and N° 2, and Archival card catalog) were collected in this expedition and housed in the MLP-PV in 1889. Many of the specimens from the RSC collected by C. Ameghino in 1887 and S. Pozzi in 1888 were later studied by the Swiss geologist Alcides Mercerat (18?? –1934; Fig. 1.5) (Mercerat 1891a, 1891b, 1891c; Moreno & Mercerat, 1891) who replaced F. Ameghino as paleontologist of the MLP in 1889.

Between 1891 and 1894, there were two new expeditions to the Santa Cruz territory. The first one, in 1891, was carried out by the "*Naturalista Viajero del Museo de La Plata*" Carlos Germán Venancio Burmeister (1867–1951)—the eldest son of C. Germán Conrado Burmeister (Fig. 1.4)—together with the MLP employees Emilio Beaufils, J. Ivovich, and Federico Berry. In 1894, F. Berry conducted the second expedition and collected approximately 86 specimens that were housed in the MLP-PV collection in September 1895 (Fig. 5.1–4).

In 1893 and 1894, the English naturalist and geologist Richard Lydekker (1849–1915; Fig. 1.8), visited Argentina invited by F. P. Moreno and spent some months studying the collection of fossil vertebrates of the MLP. His work, including many illustrations, was published in the "Anales del Museo de La Plata" volumes II and III (Lydekker, 1894, 1895). Lydekker gave the first satisfactory account of several of the peculiar extinct vertebrates of South America, *i.e.*, dinosaurs and cetaceans from Patagonia and South American ungulates. His descriptions and figures of the Nesodontinae from the SCF (Lydekker, 1895) are especially valuable. In his study, Lydekker synonymized most of the species erected by Ameghino (1887a) and Mercerat (1891b) (see Appendix), and figured several type specimens studied by Ameghino (1887a), *i.e.*, MLP-PV 12-2 *Acrotherium patagonicum* (plate XV, fig. 2), *Adinotherium magister* (plate XVI, fig. 3), and MLP-PV 12-4 *Adinotherium magister* (plate XVI, fig. 1) (Fig. 6.1–3).

MATERIALS AND METHODS

Cataloging of fossil vertebrates is the process by which all the parts of a specimen are linked to their associated information (identification, anatomical description, locality, stratigraphy, age, collector, date, and any other relevant data) through a catalog number, a single identifying number that should be marked on the fossil when possible. Also, cataloging is the process of creating metadata representing information resources, such as books and inventory ledgers.

In order to review all toxodontid specimens from the SCF of the "Old Collections", we conducted an exhaustive search and revision of the drawers and shelves of the collection storages. Approximately 780 specimens were identified and analyzed, and their associated information was tracked and verified based on two main sources, as follows.

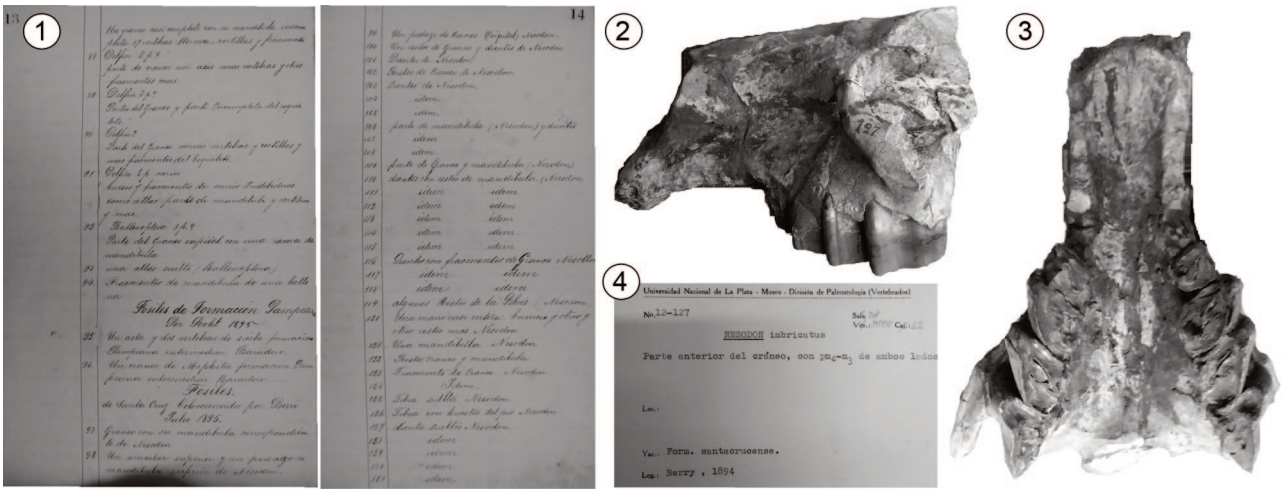


Figure 5. Federico Berry collection from **SCF**, 1894. **1,** Registration of the collection in in the **RBFV N° 1** (p. 13–16), September 1895; **2–4, MLP-PV 12-127**, ***Nesodon imbricatus***, incomplete skull with P4-M3 left and right series; **2,** in lateral view and **3,** in occlusal view (note the number 127); **4,** Catalog card.

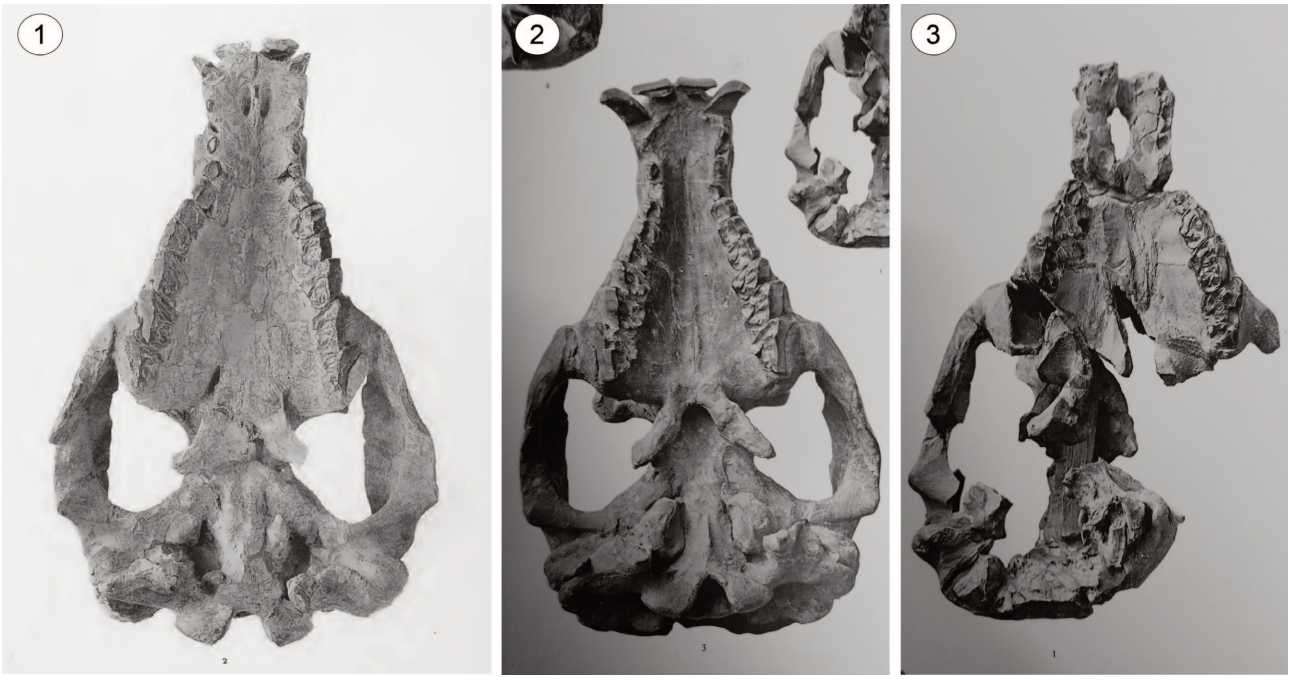


Figure 6. Nesodontines from **RSC** figured by Lydekker (1895). **1,** Syntype **MLP-PV 12-6** ***Adinotherium magister*** Ameghino (plate XVI, fig. 1); **2,** Syntype **MLP-PV 12-2** ***Adinotherium magister*** Ameghino (plate XV, fig. 2); **3,** Syntype **MLP-PV 12-4** ***Adinotherium magister*** Ameghino (plate XVI, fig. 3).

Fossils as a primary source of data (Figs. 7–8)

- Identification of the handwriting labels adhered on the fossil by F. Ameghino in 1886–1887 and by A. Mercerat in 1889–1891 (Figs. 7.1–3, 8.1–2).
- Acronyms written in the fossil with India ink, probably by S. Roth in the period 1895–1896 (see below) (Figs. 7.3–4, 8.1–2).

MLP-PV archival documents (books) (Fig. 9)

- Book Catalog of Fossil Vertebrates N° 1 (BCFV N° 1)—*Libro Catálogo de Vertebrados Fósiles* N° 1, Notungulata [*sic*], Folios 447–474—(1895–1925; Fig. 9.1).
- Book Catalog of Fossil Vertebrates N° 3 (BCFV N° 3)—*Libro Catálogo de Vertebrados Fósiles* N° 3, Notungulata [*sic*], Folios 21–79—(1895–1925).
- Record Book of Fossil Vertebrates N° 1 (RBFV N° 1)—*Libro de Registro de Vertebrados Fósiles* N° 1—(1925–1952).
- Record Book of Fossil Vertebrates N° 2 (RBFV N°2)—*Libro Registro de Vertebrados Fósiles* N° 2— (1911/27–1953/57).
- Record Book of Fossil Vertebrates N° 3 (RBFV N°3)—*Libro de Registro de Vertebrados Fósiles* N° 3—(1955–1969).
- "*Inventario de las existencias del Museo de La Plata-Inventario de la Sección Paleontológica*" by Roth (1902). MLP internal inventory report, unpublished, p. 51–65. (Fig. 9.2)
- DPV Internal report fossil vertebrate listing of the MLP exhibitions, *ca.* 1905 (Fig. 9.3).
- Archival card catalog (implemented during 1955–1956) (Fig. 9.4–7).

Finally, the information was compared and verified with published catalogs or synopsis and relevant bibliography that include: Ameghino (1887a, 1887b, 1889), Mercerat (1891a, 1891b, 1891c), Moreno & Mercerat (1891), Lydekker (1895), and Mones (1986).

EARLY PHASE (1887–1903) OF THE CATALOGING SYSTEM: HANDWRITING LABELS, ACRONYMS, AND SEQUENTIAL NUMBERING

Labels with author's handwriting attached to the specimens from RSC

The MLP-PV "Old Collections" include numerous specimens (among them, holotypes and syntypes) that keep original handwriting labels (Figs. 7–8). These old labels, lightly attached to the specimens, have been frequently

partially peeled away and the ink is fading, making it very difficult to read. Handwriting recognition for deciphering the authorship of labels has been surveyed following Breure (2013). Positive identification of authorship was facilitated by comparing with other documents, such as correspondence and internal reports from DPV collection archives. The diversity and the regular preservation of these labels provide an important historical and scientific value to those collections (Figs. 10–11). The analysis of this information allowed narrowing down the manufacturing date of these labels to the 1886–1887 and 1889–1890 years of the 19th century and F. Ameghino and A. Mercerat were identified as the main authors, respectively.

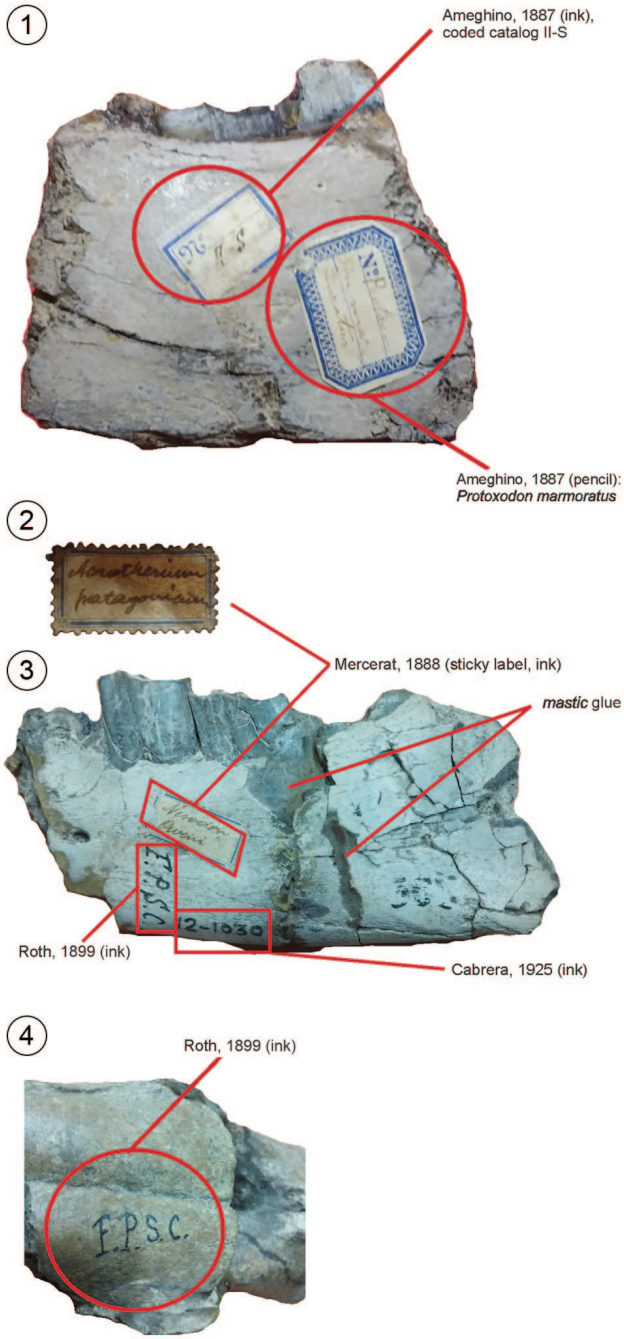


Figure 7. Taxonomic identification and coded labels and acronyms on Nesodontinae specimens from **SCF**. **1,** F. Ameghino's identification and coded catalog sticky labels; **2–3,** A. Mercerat identification labels; **4,** S. Roth acronym "**F.P.S.C**". Note that the specimens were repaired using *mastic* glue (a mixture of gypsum, virgin wax, and vegetal resin).

Florentino Ameghino was the first that used handwriting labels attached on the fossils for cataloging and curating the "Pampean" collection that he sold to the MLP in 1886 (Fig. 10.2) and the SCF collection made by F. P. Moreno (1876–1877) and C. Ameghino (1887) in the cliffs of the RSC (Fig. 10.1–8). For the SCF, he used 27 x 19 mm template size labels, with serrated or smooth edges and round corners (Fig. 10.1, 10.3–8). In each specimen identified so far, we found two labels: one with the taxonomic identification and the other with a probable geographic code (localities) supplied by C. Ameghino. There is no written record of what the code means, but it includes Roman numbers (I to IIII), and the letters S and N, separate by a dash (*e.g.*, II-S; Fig. 10.4, 10.6–7), and in some cases, followed by an Arabic number between brackets (*e.g.*, I-S-(3); Fig. 10.6–7). Based on information from Fernicola *et al.* (2014), we tentatively assume that they correspond to the localities prospected in 1887 by C. Ameghino in the south and north banks of the RSC.

As mentioned above, between 1889 and 1891, A. Mercerat had an important role in the management of the nesodontine collections made by F. P. Moreno, C. Ameghino, and S. Pozzi. Mercerat curated and studied the specimens and drew up extensive catalogs with brief descriptions, but without figures, of Santacrucian terrestrial mammals and birds (Mercerat, 1891a, 1891b, 1891c; Moreno & Mercerat, 1891). Mercerat (1891a) named and described 28 new taxa of Nesodontinae (Toxodontidae) from Santa Cruz (Tab. 1). Most of the specimens restudied are identifiable by labels on the fossils with taxonomic identification data handwritten in India ink (Fig. 11.2–10). Mercerat used square cornered label template size (27 x 15 mm; Fig. 13.1) with serrated or smooth edges. Interestingly, and probably erroneously, A. Mercerat labeled several type specimens of

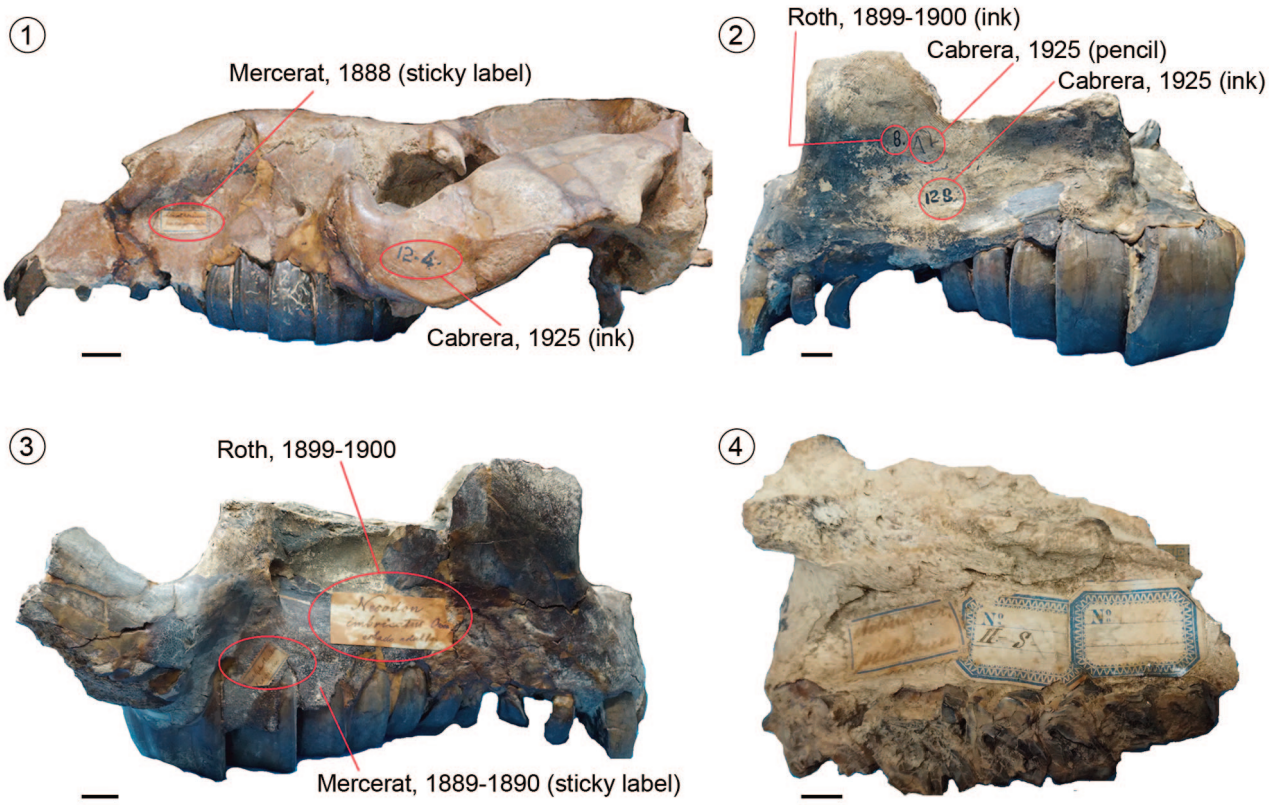


Figure 8. Identification and sticky labels on the fossil. **1,** Left lateral view of **MLP-PV 12-4**, holotype of ***Acrotherium patagonicum*** Mercerat, 1891; **2–3,** Left and right lateral views of **MLP-PV 12-8**, syntype of ***Adelphotherium trivium*** Mercerat, 1891; **4, MLP-PV 55-XII-13-5**, ***Adinotherium splendidum*** Ameghino, left maxilla with P2-M3; A. Mercerat's taxonomic label: ***Adinotherium pulchrum***, F. Ameghino coded original label: II-S-, and A. Mercerat's taxonomic identification original label: ***Adinotherium splendidum***.

Nesodontinae from RSC with the name *Trematherium*; *i.e.*, "*Trematherium kobyi*" (*in schedula*, *nomen nudum*; Fig. 11.2), "*Trematherium rutilum*" (*in schedula*, *nomen nudum*; Fig. 11.3), "*Trematherium patagonensis*" (*in schedula*, *nomen nudum*; Fig. 11.4), "*Trematherium ingens*" (*in schedula*, *nomen nudum*; Fig. 11.5), "*Trematherium argentinum*" (*in schedula*, *nomen nudum*; Fig. 11.6) as type specimens of Nesodontinae from RSC. Unfortunately, *Trematherium* had been first used by Ameghino (1887b) to name a Megalonychidae (Xenarthra, Folivora) from the RSC, whose type species is *Trematherium intermixtum,* MLP-PV 4-45 (Fig. 10.8).

In 1892, A. Mercerat left the MLP, abandoned the study of Santacrucian fossils, and continued with the geologic investigations in Patagonia (Mercerat, 1893, 1895, 1896).

Acronyms and sequential numbering, book catalog

In 1895, F. P. Moreno designated the Swiss S. Roth (1850–1924; Fig. 1.9) as Head of the *Sección Paleontología* to replace A. Mercerat. The museum collections and research were fundamental components of S. Roth's activities in the MLP, including field works, specimen preparation, conservation and cataloging, public education and outreach, and staff management (Sánchez Villagra *et al.*, 2023). While managing the MLP-PV collection, S. Roth undertook an active role in the fossils cataloging. One of his first tasks was to implement a cataloging system (acronyms and numbers) for the fossil samples. In 1896, he used the same system for all the fossils he collected during the trips to Río Negro, Neuquén, and Chubut provinces, recording with initials (acronyms) the geologic/geographic provenance and numbering the samples with tags of different colors. He labeled the fossils with acronyms handwritten in black India ink (Fig. 7.4), *e.g.*, *T.m.C.* ("*Terciario medio Collón Curá*"), *T.i.C.B.* ("*Terciario inferior Cañadón Blanco*"), *C.s.M.* ("*Cretácico superior Muster*"), and the sequential numbering also written onto the fossils (Vera & Reguero, 2023; Sánchez Villagra *et al.*, 2023).

Probably in 1895, S. Roth started labeling all the fossil vertebrates collected in the SCF with the acronym "*F.P.S.C.*" ("*Formación Patagónica Santa Cruz*") (Fig. 7.4).

Mercerat also labeled as "*F.P.S.C.*" some specimens collected by the MLP expedition to Chubut in 1888 by C. Ameghino, E. Botello, and A. Steinfeld, which were erroneously considered Santacrucian in age, considering they come from older (Deseadan?) strata. This collection includes the astrapotheriid *Astrapotherium voghti* Mercerat, 1891 (syntypes MLP-PV 12-105, MLP-PV 12-122, MLP-PV 12-1081, and MLP-PV 12-1089) from an undetermined Carhué locality, *Astrapotherium* sp. (MLP-PV 12-1113) from Puerto Madryn, and *Trachytherus spegazzinianus* (MLP-PV 52-XI-2-1) probably from Choiquenilahue.

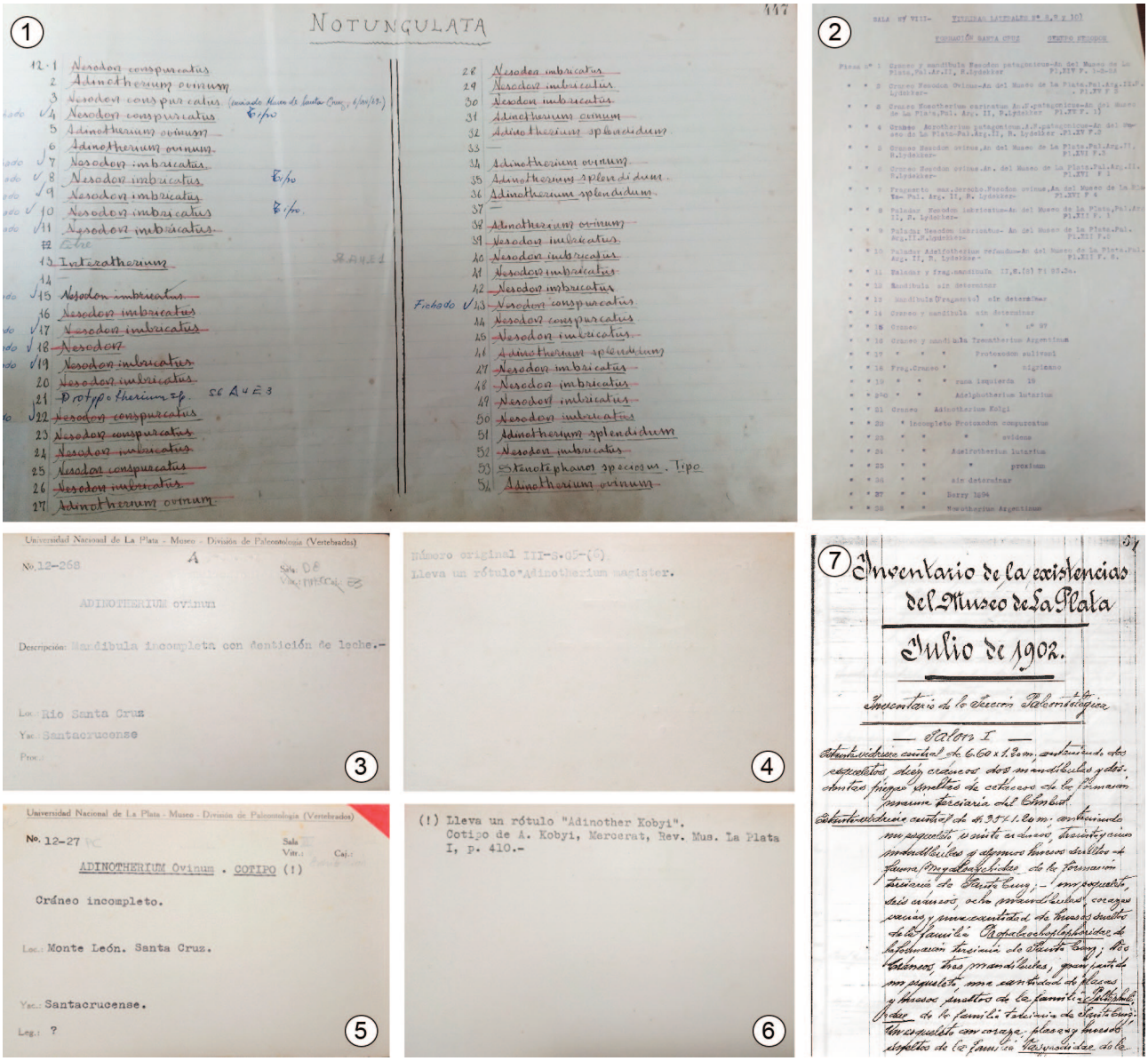


Figure 9. DPV Ledgers and archives: **1,** First page of the **BCVF N° 1**: Notungulata (sic) (p. 447); **2, DPV** Internal Report fossil vertebrate listing of the **MLP** exhibition in 1902: *Sala VIII-Vitrinas laterales* N° 8, 9 y 10-Formación Santa Cruz- género *Nesodon*; **3,** Archival catalog card **MLP-PV 12-268**, *Adinotherium ovinum*, incomplete mandible with milk dentition; **4,** Reverse side of the archival card **MLP-PV 12-268**, "*Número original* III-S.G5-(6). *Lleva un rótulo "Adinotherium magister"*; **5,** Archival catalog type card **MLP-PV 12-27**, *Adinotherium ovinum*, incomplete skull, "Cotype"; **6,** Reverse side of the archival card **MLP-PV 12-27**, "*Lleva un rótulo 'Adinother Kobyi'. Cotipo de A. Kobyi*, Mercerat, Rev. Mus. La Plata, I, p. 410"; **7,** First page of S. Roth report to the **MLP** (July of 1902, *"Inventario de las existencias del Museo de La Plata- Inventario de la Sección Paleontológica", Folios* 51–65).

Approximately between 1895 and 1896, S. Roth implemented the first book catalog of fossil vertebrates (BCFV N° 1) and the first record book of fossil vertebrates (RBFV N° 1) of the MLP-PV collection. In the BCFV N° 1, S. Roth subdivided the entries into 16 systematic groups plus one of casts: Megatheriidae (p. 1), Mylodontidae (p. 51), Megalonychidae (p. 250), Cetacea (p. 381), Perissodactyla (p. 391), *Calcos varios* (p. 399), Proboscidea (p. 411), Artiodactyla (p. 425), Carnivora (p. 433), Marsupialia (p. 441), Notungulata (*sic*), (p. 447), Pyrotheria (p. 475), Insectivora (p. 477), Rodentia (p. 479), Xenartha (Glyptodontidae) (p. 491), Condylarthra (p. 559), and Pisces (p. 563) (Figs. 6.1 and 12) and listed in each group the name of the specimens with the same sequential numbering. In Notungulata (*sic*) of the BCFV N°1 (pp. 447–474) (Fig. 6.1), he also included litopterns and astrapotheres and 1,566 specimens of notoungulates from the SCF. In total, S. Roth listed 322 specimens of nesodontines from the SCF collected by F. P. Moreno (1876–1877), C. Ameghino (1887), S. Pozzi and C. Onelli (1888–1889), and F. Berry (1889). For their identification, S. Roth adopted the names considered valid by Lydekker (1895) and Ameghino (1891, 1894, 1895): *Nesodon* sp., *Nesodon imbricatus, Nesodon conspurcatus, Adinotherium, Adinotherium ovinum, Adinotherium splendidum, Adinotherium nitidum, Rhadinotherium limitatum,* and *Stenotephanus speciosus* (see Appendix).

Figure 10. Different labels with author's handwriting adhered on specimens from the "Old Collection" ("Pampean" and Nesodontinae from **SCF**) of the **MLP**, 1886–1888. **1,** Square cornered label template size (27 x 18 mm) with serrated or with smooth edges; **2,** Two different series of labels originating from F. Ameghino in 1886 ("Pampean") Collection: left ***Lama guanicoe*** (Camelidae) "*192 Amegh, Luján*", right ***Lama guanicoe*** (Camelidae) "*220 Amegh, Luján*"; **3, "*Protoxodon patagonensis*"** on **MLP-PV 12-43**, taxonomic identification original label; **4, "*Protoxodon patagonensis*"** on **MLP-PV 12-43**, coded original label: "I-S-(3)"; **5,** Ameghino taxonomic identification original label: ***Protoxodon obliteratus*** on syntype **MLP-PV 12-940**; **6,** F. Ameghino original label: "III-S-G5-(1)" on syntype **MLP-PV 12-940**; **7,** F. Ameghino coded original label: "I-N-(5)" on **MLP-PV 12-42** ***Adelphotherium trivium***; **8,** F. Ameghino handwriting taxonomic identification label (amended) ***Trematherium intermixtum*** associated to the holotype **MLP-PV 4-45**; **9–12,** Different handwritten labels by S. Roth, 1899–1900.

TABLE 1– Species of Toxodontidae from the SCF erected by Ameghino (1887a, 1887b) and Mercerat (1891b)

Ameghino (1887a, 1887b)	Mercerat (1891b)
Protoxodon patagonensis	*Acrotherium patagonicum*
Protoxodon conspurcatus	*Acrotherium australe*
Protoxodon marmoratus	*Acrotherium intermedium*
Protoxodon obliteratus	*Acrotherium variagatum*
Protoxodon sulivani (Owen)	*Acrotherium mutabile*
Adelphotherium ligatum	*Nesodon bifurcatus* (Ameghino)
Acrotherium rusticum	*Nesodon oweni*
Gronotherium decrepitum	*Nesodon cyclops* (Ameghino)
Adinotherium magister	*Nesodon rutimeyeri*
Adinotherium splendidum	*Nesodon typicus*
Adinotherium proximum	*Nesodon limitatun* (Ameghino)
Adinotherium ferum	*Adinotherium pulchrum*
Adinotherium nitidum	*Adinotherium silvaticum* (Ameghino)
Phobereotherium silvaticum	*Adinotherium antiquum*
Atryptherium bifurcatum	*Adinotherium kobyi*
Scophotherium cyclops	*Nesotherium carinatum*
Rhadinotherium limitatum	*Nesotherium studeri*
	Nesotherium elegans
	Nesotherium rufum
	Nesotherium patagonense (Ameghino)
	Nesotherium turgidum
	Nesotherium rutilum
	Nesotherium argentinum
	Nesotherium nehringi
	Nesotherium burmeisteri
	Protoxodon evidens
	Protoxodon clemens
	Protoxodon trouessarti
	Protoxodon americanus
	Protoxodon decrepitus (Ameghino)
	Protoxodon henseli
	Protoxodon speciosus
	Adelphotherium lutarium
	Adelphotherium trivium

Figure 11. Mercerat handwriting label (taxonomic identifications, *nomina dubia*, *in schedula*), 1889–1892. **1,** Square cornered label template size (27 x 15 mm) with serrated or with smooth edges; **2, "*Trematherium kobyi*"** on **MLP-PV 12-1035** (*nomen nudum*); **3, "*Trematherium rutilum*"** (*nomen nudum*) on **MLP-PV 12-70**; **4, "*Trematherium patagonensis*"** (*nomen nudum*), on **MLP-PV 12-4** (note that *Trema* was amended by *Neso* in blue ink); **5, "*Trematherium ingens*"** (*nomen nudum*) on **MLP-PV 12-57**; **6, "*Trematherium argentinum*"** (*nomen nudum*) on **MLP-PV 12-16**; **7. *Adelphotherium trivium*** on **MLP-PV 12-8**; **8. *"Adelphotherium pumilum"*** on **MLP-PV 12-25**; **9. *Acrotherium patagonicum*** on **MLP-PV 12-44**; **10. *Nesodon oweni*** on **MLP-PV 12-962**.

At the beginning of the 20th century, the MLP organized the first presentation and display of the fossil vertebrate collections, among others. In July 1902, S. Roth provided a summary of the pieces in his "*Inventario de las existencias del Museo de La Plata-Inventario de la Sección Paleontológica*" (*Folios* 51–65). He reported that in the exhibition today identified as *Salas* VII and VIII (Fig. 13), most Nesodontinae specimens (including all the types) from the SCF studied by F. Ameghino and A. Mercerat were on display in wood and

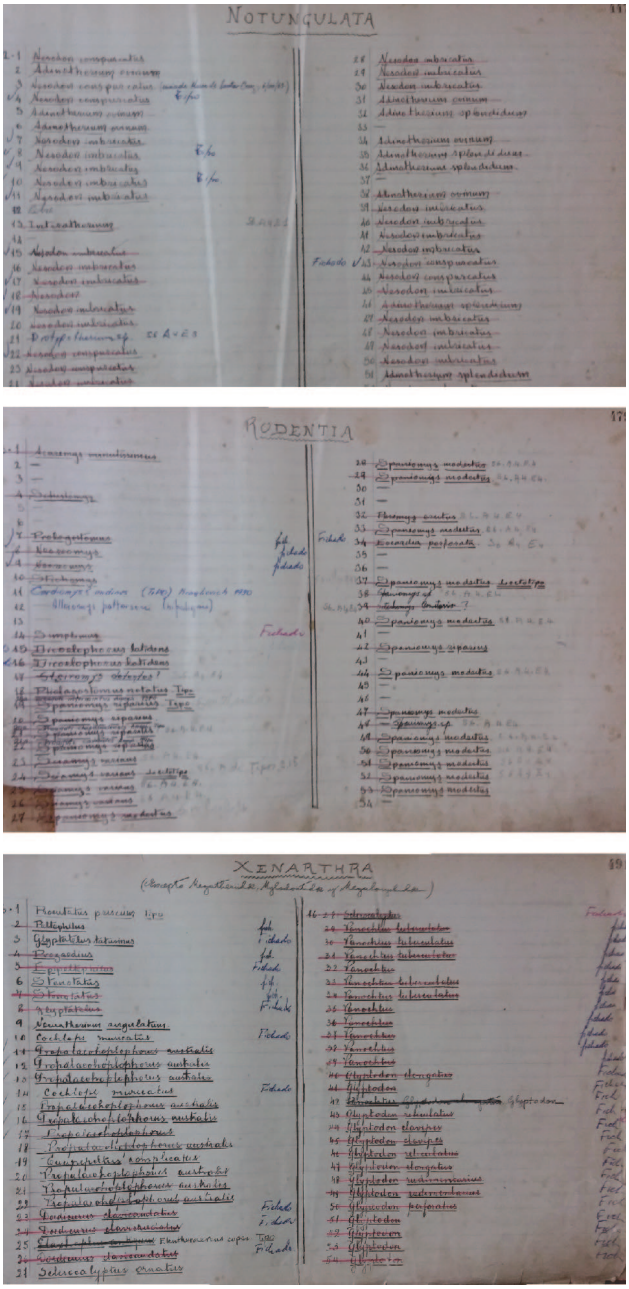


Figure 12. First pages of the **BCVF** N° 1: Notungulata (*sic*) (p. 447), Rodentia (p. 479), and Xenarthra (p. 491).

glass showcases. They included: 45 skulls, 100 maxillae, and 115 mandibles (a total of 260 specimens) of *Nesodon* and *Adinotherium*. Also, in the cabinets at the bottom of the showcases, there were 36 wooden boxes containing approximately 10,000 remains of fossil vertebrates from the "*formación terciaria de Santa Cruz*" (most of them labeled with the acronym "*F.P.S.C.*").

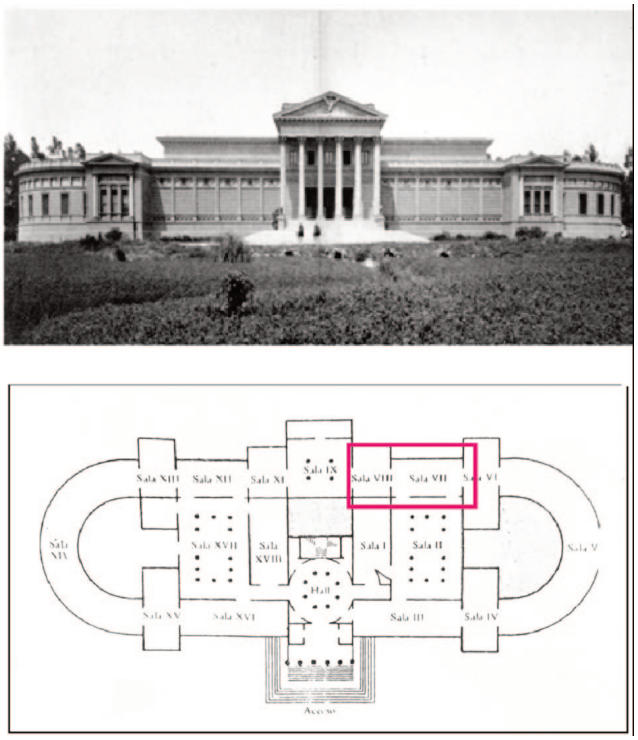


Figure 13. MLP in early 1900s. Old distribution of the exhibition halls ("*Salas*"), from the Archivo Histórico del Museo de La Plata. The red square is positioned on *Salas* VII and VIII (Exhibition of nesodontines from **SCF**).

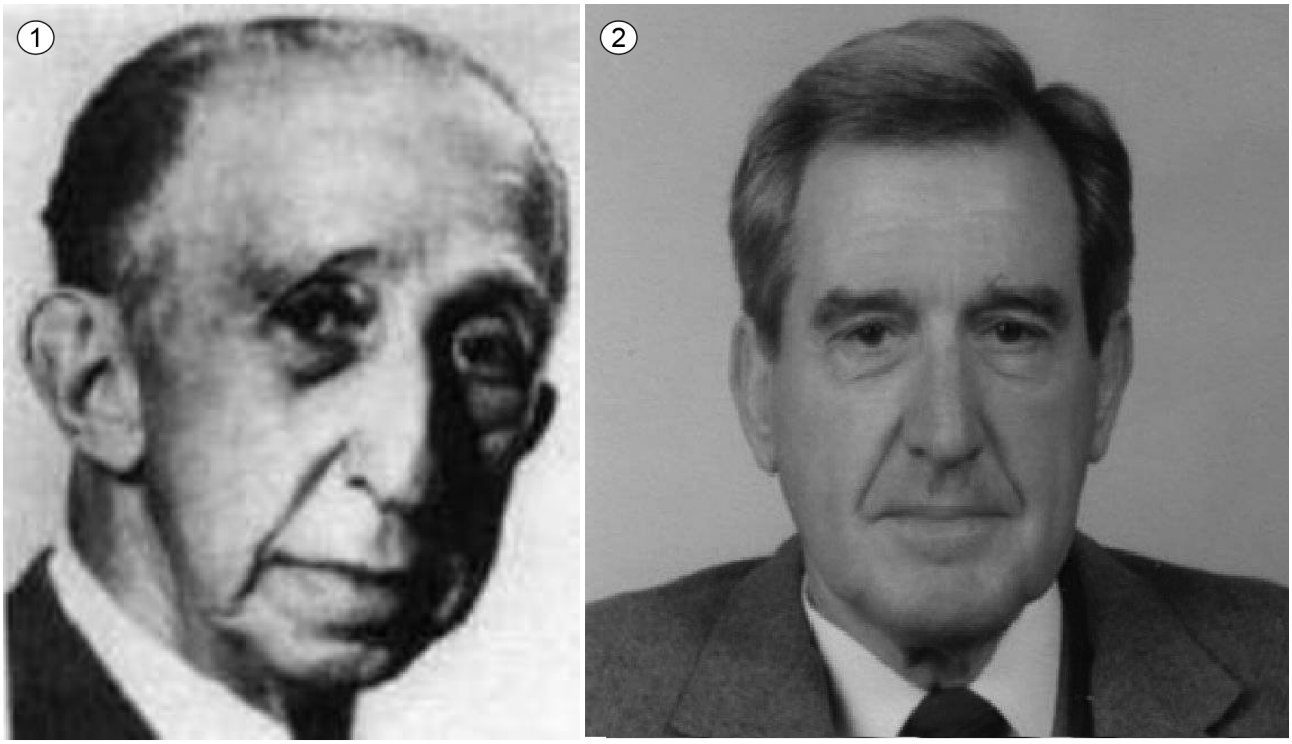
MODERN PHASE (1925–1968) OF THE CATALOGING SYSTEM: NEW CATALOG NUMBERS AND CATALOG CARDS

After Roth's passing in 1924, the Director of the MLP Luis María Torres (1878–1937) offered the position of *Jefe de Departamento de Paleontología* to the Spanish Angel L. Cabrera (1879–1960; Fig. 14.1). He understood that the specimens of the collection should be referred by their catalog number in scientific publications, which was not a common practice until that time. In September 1925, the cataloging numbering of the MLP-PV collection changed to a new system: indicating year, month (in Roman), day, and sequential number separated by hyphens (*e.g.*, 25-X-2-1). However, for the early collections, A. L. Cabrera kept the sequential numbering system adopted by S. Roth in the BCFV N° 1 and N° 2, but he added a digit for the 16 systematic group entries, followed by a hyphen before the sequential number (Fig. 8.1–2). The digits were defined as follow: **2-** Megatheriidae, **3-** Mylodontidae, **4-** Megalonychidae, **5-** Cetacea, **6-** Perissodactyla, **7-** *Calcos varios*, **8-** Proboscidea, **9-**Artiodactyla, **10-** Carnivora, **11-** Marsupialia, **12-**

Notungulata (*sic*) (including Notoungulata, Astrapotheria, and Litopterna), **13-** Pyrotheria, **14-** Insectivora, **15-** Rodentia, **16-** Xenarthra (Glyptodontidae), **17-** Condylarthra, and **21-** Pisces. With this slight modification of the cataloging in the BCFV N° 1 and N° 2, A. L. Cabrera supported the idea that citing the catalog number ensures that everyone is looking at the same specimen and the same set of associated information.

The remaining specimens from the SCF were cataloged in the mid-1950s, when Héctor A. Orlando was the Head of the *División Paleontología* of the MLP, and R. Pascual (Fig. 14.2), section assistant of *División Paleontología.* In 1955, R. Pascual together with the technician Lorenzo Julio Parodi (1890–1969), started to organize and classify the rest of the "Old Collection" from SCF housed in the MLP-PV and made the first archival card catalog (Fig. 9.4–7). They unpacked and made some curatorial transactions, registration, and cataloging of specimens that had not been yet processed since they arrived to the MLP. In some cases, it was impossible to determine who was the collector, given the sparse information associated with them.

In 1955 and 1968, two important curatorial transactions were done regarding the cataloging of the remaining last specimens from the SCF: in 1955, in the BRFV N° 2 ("*folios*" 92–139) was registered the MLP-PV 55-XII-13, consisting of 480 specimens of xenarthrans and notoungulates (most of them labeled "*F.P.S.C.*") with the collecting locality "Monte León, Santa Cruz". In this collection, there were 165 nesodontine specimens: 124 of *Nesodon* sp. and 41 specimens of *Adinotherium* sp. Among them there were some type specimens labeled by F. Ameghino and A. Mercerat; for example, the syntype of *Adinotherium antiquum* Mercerat, 1891 (MLP-PV 55-XII-13-40, old number 145) collected apparently by S. Pozzi in the 1888–1889 expedition. Some other specimens that did not have any label were also included in this catalog number. It is possible that they were collected in the expedition of C. Burmeister to the SCF in 1891 and that was kept packed, hidden, and away from systematic studies and curatorial actions (cataloging) for many years.



Angel L. Cabrera (1879-1960)

Rosendo Pascual (1925-2012)

Figure 14. 1. Angel L. Cabrera, from the Archivo Histórico del Museo de La Plata; **2.** Rosendo Pascual, from M. Reguero.

In 1968, a second important curatorial transaction was registered in RBFV N° 3 with the catalog number MLP-PV 68-VI-25 comprising 500 specimens from Santa Cruz (most of them labeled "*F.P.S.C.*"). There were 195 nesodontines cataloged: 148 referred to *Nesodon* sp. and 147 to *Adinotherium* sp. As in the previous transaction of 1955, some type specimens labeled by F. Ameghino and A. Mercerat were registered in this collection. For example, the syntype of *Adinotherium antiquum* Mercerat, 1891, MLP-PV 68-VI-25-11 (old number 150) from Monte León, Santa Cruz, probably collected by S. Pozzi, 1888–1889, and the syntype of *Nesotherium patagonensis*, MLP-PV 68-VI-25-10 from the RSC collected by C. Ameghino (Fig. 4.2). In addition, many specimens of this transaction did not have any label or geographic provenance and probably belong to the C. Burmeister expedition to the FSC in 1891.

As a summary, in Figure 15 we provide the main steps of the early and modern phases of the curatorial and cataloging procedures performed on the Toxodontidae Nesodontinae collection from SCF housed in the MLP-PV collection.

CONCLUSIONS

In this contribution, we reviewed the curatorial and cataloging procedures made between 1884 and 1902 on specimens from the "Old Collections" housed in the MLP-PV collection. For our purpose, we selected the notoungulate mammals Toxodontidae Nesodontinae from the Santa Cruz Formation (Early–Middle Miocene). Our goal was to organize and curate this collection, which was subjected to different curatorial processes when the Vertebrate Paleontology collections of the MLP began to be classified. Our main results can be summarized as follows:

- More than 800 nesodontines cataloged from the "Old Collections" of the SCF were thoroughly reviewed, recording and analyzing their associated information.
- At least two types of handwriting labels were identified. The analysis of the information provided in the labels allowed narrowing down the manufacturing date of these labels to the 1886–1887 and 1889–1890 years of the 19th century and F. Ameghino and A. Mercerat, respectively, were identified as the main authors.
- The diversity and the regular preservation of these labels provide an important historical and scientific value to those collections.
- The archival card catalog of the collection, performed in 1955–1956, contains accurate and very useful processed metadata associated with the early fossil vertebrate collections.
- Eighty-four type specimens were identified and re-cataloged. Some of them had been reported as lost in different publications (Mones, 1986; Hernández Del

	Early phase (1887-1903) of the cataloging system			Modern phase (1925-1968) of the cataloging system			
	Old MLP cataloging system (1887-1891) Labels on the fossils from F. Ameghino and A. Mercerat	Roth MLP cataloging system (1895-1898). Acronym placed on the fossils and sequential numbering.	Roth MLP cataloging system (1901-1903). DPV Catalog Book of Fossil Vertebrates N° 1 and N° 2. First MLP Exhibition.	Cabrera MLP cataloging system (1925). DPV Record Book of Fossil Vertebrates N° 1 ("Notungulata"). New catalog number and cataloging system.	Pascual MLP cataloging system (1925). DPV Record Book of fossil vertebrates N° 3. Archival catalog cards (1955-1956).		
SCF Nesodontinae * (number of specimens)	Sticky labels	F.P.S.C.	F.P.S.C. + number	F.P.S.C + catalog number: MLP 12-	F.P.S.C. + MLP 55-XII-13 Monte León	F.P.S.C. + MLP 68-VI-25	
Nesodon	234	234	234	234	124	148	
Adinotherium	84	84	84	84	41	147	
Rhadinotherium	1	1	1	1			
Stenotephanos	3	3	3	3			
				322	165	295	Total: 782 specimens

* After Roth´s identifications in the DPV Catalog Book of Fossil Vertebrates N° 1

Figure 15. Early (1887–1903) and Modern (1925–1068) phases of the curatorial transactions and cataloging system of the **MLP** "Old Collections".

TABLE 2 – Type specimens of Nesodontinae (Notoungulata, Toxodontidae) of the "*F.P.S.C.*", "Old Collections" of the MLP

Catalog number	Identification	Description	Type	Locality	Age	Collector	Figured
MLP-PV 12-1	*Protoxodon conspurcatus* Ameghino, 1887	Skull and mandible	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	Lydekker (1895, pl. XIV, fig. 1.2, 2a)
MLP-PV 12-2	*Adinotherium magister* Ameghino. 1887	Skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	Lydekker (1895, pl. XV, fig. 3)
MLP-PV 12-3	*Nesotherium carinatum* Mercerat, 1891	Skull and mandible	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	Lydekker (1895, pl. XV, fig. 1)
MLP-PV 12-4	*Acrotherium patagonicum* Mercerat, 1891	Skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	Lydekker (1895, pl. XV, fig. 2)
MLP-PV 12-5	*Adinotherium magister* Ameghino, 1887	Skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-6	*Adinotherium magister* Ameghino, 1887	Skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	Lydekker (1895, pl. XVI, fig. 1)
MLP-PV 12-8	*Adelphotherium trivium* Mercerat, 1891	Palate with premolars and molars	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	Lydekker (1895, pl. XII, fig. 1)
MLP-PV 12-10	*Adelphotherium repandum* Mercerat, 1891	Skull	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-15	*Adelphotherium lutarium* Mercerat, 1891	Skull and mandible	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-16	*Nesotherium argentinum* Mercerat, 1891	Skull and mandible	Syntype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-17	*Protoxodon sulivani* Mercerat, 1891	Skull and mandible	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-19	*Adelphotherium ligatum* Ameghino, 1887	Skull	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-20	*Adelphotherium lutarium* Mercerat, 1891	Incomplete skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-23	*Protoxodon evidens* Mercerat, 1891	Rostrum	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-24	*Adelphotherium lutarium* Mercerat, 1891	Incomplete skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-25	*Adelphotherium pumilum* Mercerat, 1891	Incomplete skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 55-XII-13-247	*Adelphotherium pumilum* Mercerat, 1891	Incomplete skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-26	*Adelphotherium lutarium* Mercerat, 1891	Incomplete skull	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-27	*Adinotherium kobyi* Mercerat, 1891	Incomplete skull	Syntype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-28	*Nesotherium argentinum* Mercerat, 1891	Incomplete skull	Syntype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-29	*Nesotherium turgidum* Mercerat, 1891	Incomplete skull	Holotype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-31	*Adinotherium magister* Ameghino, 1887	Incomplete skull	Syntype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-32	*Adinotherium pulchrum* Mercerat, 1891	Incomplete skull with right p1-m3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 55-XII-13-5	*Adinotherium pulchrum* Mercerat, 1891	Left maxilla with P2-M3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-38	*Phobereotherium sylvaticum* Ameghino, 1887	Incomplete skull	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-40	*Adelphotherium trivium* Mercerat, 1891	Left maxilla with P3-M3	Sintype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-41	*Adelphotherium trivium* Mercerat, 1891	Right maxilla with P4-M3	Sintype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-42	*Acrotherium rusticum* Ameghino, 1887	Left maxilla with P2-M3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	

TABLE 2– Continuation

Catalog number	Identification	Description	Type	Locality	Age	Collector	Figured
MLP-PV 12-43	*Nesotherium patagonensis* Mercerat, 1891	Left palate with P4-M3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	F. P. Moreno, 1876–1877	
MLP-PV 68-IV-25-10	*Nesotherium patagonensis* Mercerat, 1891	Right palate with P4-M3 broken	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	F. P. Moreno, 1876–1877	
MLP-PV 12-44	*Acrotherium patagonicum* Mercerat, 1891	Left maxilla with P2-M3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-46	*Adinotherium splendidum* Ameghino, 1887	Left maxilla with P4-M2	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-50	*Acrotherium rusticum* Ameghino, 1887	Rostrum with right i1-2, c-p2	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-53	*Nesodonopsis speciosus* Roth, 1899	Right maxilla with M1-3	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-55	*Acrotherium mutabile* Ameghino, 1887	Palate with right P4-M2 and left P4-M2	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-58	*Nesotherium rutilum* Mercerat, 1891	Right mandibular fragment with p4-m3	Syntype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-59	*Hyperoxotodon speciosus* Mercerat, 1895	Right maxilla with M1-3	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-62	*Acrotherium variegatum* Mercerat, 1891	Right maxilla with P4-M2	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-64	*Adelphotherium lutarium* Mercerat, 1891	Right maxilla with M1-2	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-65	*Nesodon typicus* Mercerat, 1891	Fragment of maxilla with teeth	Syntype	Monte León, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-68	*Nesodon rutimeyeri* Mercerat, 1891	Mandibular fragment with two molars of juvenile	Syntype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-71	*Acrotherium mutabile* Mercerat, 1891	Left maxilla with P4-M3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-86	*Nesotherium argentinum* Mercerat, 1891	Mandibular fragment with m3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-147	*Adinotherium splendidum* Ameghino, 1887	Fragment of palate with P4-M1-3 right and left series	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-158	*Protoxodon speciosus* Mercerat, 1891	Right mandibular fragment	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-233	*Gronotherium decrepitum* Ameghino, 1887	Right mandibular fragment	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-249	*Rhadinotherium limitatum* Ameghino, 1887	Mandibular fragment with molars	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-250	*Protoxodon marmoratus* Ameghino, 1887	Mandible	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-259	*Adinotherium proximun* Ameghino, 1887	Mandible with molar series complete	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-272	*Nesodon typicus* Mercerat, 1891	Left mandibular fragment with dm 3-4 and m1	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-280	*Adinotherium splendidum* Ameghino, 1887	Left mandibular fragment with molar series	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-286	*Atryptherium bifurcatum* Ameghino, 1887	Right mandibular fragment with molar series	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-836	*Adinotherium ferum* Ameghino, 1887	Mandible incomplete	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-838	*Protoxodon clemens* Mercerat, 1891	Left mandibular fragment with broken teeth	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-847	*Protoxodon clemens* Mercerat, 1891	Right mandibular fragment	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-851	*Protoxodon obliteratus* Ameghino, 1887	Right mandibular fragment with broken molars	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	

TABLE 2– Continuation

Catalog number	Identification	Description	Type	Locality	Age	Collector	Figured
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MLP-PV 68-IV-25-10	*Nesotherium patagonensis* Mercerat, 1891	Right palate with P4-M3 broken	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	F. P. Moreno, 1876–1877	
MLP-PV 12-44	*Acrotherium patagonicum* Mercerat, 1891	Left maxilla with P2-M3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-46	*Adinotherium splendidum* Ameghino, 1887	Left maxilla with P4-M2	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-50	*Acrotherium rusticum* Ameghino, 1887	Rostrum with right i1-2, c-p2	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-53	*Nesodonopsis speciosus* Roth, 1899	Right maxilla with M1-3	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-55	*Acrotherium mutabile* Ameghino, 1887	Palate with right P4-M2 and left P4-M2	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-58	*Nesotherium rutilum* Mercerat, 1891	Right mandibular fragment with p4-m3	Syntype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-59	*Hyperoxotodon speciosus* Mercerat, 1895	Right maxilla with M1-3	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-62	*Acrotherium variegatum* Mercerat, 1891	Right maxilla with P4-M2	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-64	*Adelphotherium lutarium* Mercerat, 1891	Right maxilla with M1-2	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-65	*Nesodon typicus* Mercerat, 1891	Fragment of maxilla with teeth	Syntype	Monte León, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-68	*Nesodon rutimeyeri* Mercerat, 1891	Mandibular fragment with two molars of juvenile	Syntype	Monte León, Santa Cruz	Santacrucian	S. Pozzi, 1888–1889	
MLP-PV 12-71	*Acrotherium mutabile* Mercerat, 1891	Left maxilla with P4-M3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-86	*Nesotherium argentinum* Mercerat, 1891	Mandibular fragment with m3	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-147	*Adinotherium splendidum* Ameghino, 1887	Fragment of palate with P4-M1-3 right and left series	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-158	*Protoxodon speciosus* Mercerat, 1891	Right mandibular fragment	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-233	*Gronotherium decrepitum* Ameghino, 1887	Right mandibular fragment	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-249	*Rhadinotherium limitatum* Ameghino, 1887	Mandibular fragment with molars	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-250	*Protoxodon marmoratus* Ameghino, 1887	Mandible	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-259	*Adinotherium proximun* Ameghino, 1887	Mandible with molar series complete	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-272	*Nesodon typicus* Mercerat, 1891	Left mandibular fragment with dm 3-4 and m1	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-280	*Adinotherium splendidum* Ameghino, 1887	Left mandibular fragment with molar series	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-286	*Atryptherium bifurcatum* Ameghino, 1887	Right mandibular fragment with molar series	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-836	*Adinotherium ferum* Ameghino, 1887	Mandible incomplete	Holotype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-838	*Protoxodon clemens* Mercerat, 1891	Left mandibular fragment with broken teeth	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-847	*Protoxodon clemens* Mercerat, 1891	Right mandibular fragment	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	
MLP-PV 12-851	*Protoxodon obliteratus* Ameghino, 1887	Right mandibular fragment with broken molars	Syntype	Río Santa Cruz, Santa Cruz	Santacrucian	C. Ameghino, 1887	

Pino, 2018) (Tab. 2). Three type specimens were still not identified in the MLP-PV collection: *Acrotherium australe* Mercerat, 1891; *Acrotherium intermedium* Mercerat, 1891; and *Adelphotherium rothi* Mercerat, 1891.

- The early fossil vertebrate collections ("Old Collections") of the MLP-PV are not only archives of past-discovered knowledge but also reservoirs of potential future observations, that is, they have great "evidential value."

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APPENDIX – Summary of the Nesodontinae (Notoungulata, Tocodontidae) from the SCF at the Río Santa Cruz identified by Ameghino (1887a, b; 1889) and Mercerat (1890, 1891), and its current nomenclatural status

Ameghino (1887a, 1887b, 1889)	Synonymies and current status	Reference
Nesodon imbricatus Owen, 1847	*Nesodon imbricatus*	Scott (1912)
Nesodon sulivani Owen, 1847	*Nesodon imbricatus*	Ameghino (1891b, 1894); Lydekker (1894); Scott (1912)
Nesodon ovinum Owen, 1853	*Adinotherium ovinum*	Ameghino (1891b, 1894, 1907); Scott (1912)
Protoxodon patagonensis Ameghino, 1887a	*Nesodon imbricatus*	Ameghino (1894); Scott (1912)
Stenotephanos speciosus Ameghino, 1887b	*Hyperoxotodon speciosus*	Mercerat (1895); Madden (1990)
Protoxodon conspurcatus Ameghino, 1887b	*Nesodon conspurcatus*	Ameghino (1894); Scott (1912)
	Nesodon imbricatus	Lydekker (1894)
Protoxodon marmoratus Ameghino, 1887b	*Nesodon imbricatus*	Lydekker (1894); Scott (1912)
Protoxodon obliteratus Ameghino, 1887b	*Nesodon imbricatus*	Lydekker (1894); Scott (1912)

APPENDIX – Continuation

Ameghino (1887a, 1887b, 1889)	Synonymies and current status	Reference
Adelphotherium ligatum Ameghino, 1887b	*Nesodon imbricatus*	Ameghino (1894); Lydekker (1894); Scott (1912)
Acrotherium rusticum Ameghino, 1887b	*Nesodon imbricatus*	Lydekker (1894); Scott (1912)
Gronotherium decrepitum Ameghino, 1887b	*Nesodon imbricatus*	Scott (1912)
Adinotherium magister Ameghino, 1887b	*Adinotherium ovinum*	Scott (1912)
Adinotherium splendidum Ameghino, 1887b	*Adinotherium splendidum*	Scott (1912)
Adinotherium proximum Ameghino, 1887b	*Adinotherium ovinum*	Ameghino (1904); Scott (1912)
Adinotherium ferum Ameghino, 1887b	*Adinotherium ovinum*	Scott (1912)
Adinotherium nitidum Ameghino, 1887b	*Adinotherium nitidum*	Scott (1912)
Phobereotherium silvaticum Ameghino, 1887b	*Adinotherium silvaticum*	Mercerat (1891)
	Nesodon sylvaticum	Lydekker (1893)
	Phobereotherium silvaticum	Scott (1912)
Atryptherium bifurcatum Ameghino, 1887b	*Nesodon imbricatus*	Ameghino (1894)
	Nesodon conspurcatus	Scott (1912)
Scophotherium cyclops Ameghino, 1887b	*Nesodon imbricatus*	Ameghino (1894); Scott (1912)
Rhadinotherium limitatum Ameghino, 1887b	Toxodontia *incertae sedis*	Scott (1912)
Nesodon oweni Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894); Scott (1912)
Nesodon rutimeyeri Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894)
	Nesodon conspurcatus	Scott (1912)
Nesodon typicus Mercerat, 1891	*Nesodon imbricatus*	Scott (1912)
Adinotherium pulchrum Mercerat, 1891	*Adinotherium splendidum*	Ameghino (1894); Scott (1912)
Adinotherium antiquum Mercerat, 1891	*Adinotherium splendidum*	Scott (1912)
Nesotherium carinatum Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894)
	Nesodon conspurcatus	Scott (1912)
Nesotherium studeri Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894); Scott (1912)
Nesotherium elegans Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894)
	Nesodon conspurcatus	Scott (1912)
Nesotherium rufum Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894); Scott (1912)
Nesotherium nehringi Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894); Scott (1912)
Nesotherium argentinum Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894); Lydekker (1894); Scott (1912)
Protoxodon evidens Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894)
	Nesodon conspurcatus	Scott (1912)
Protoxodon americanus Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894); Scott (1912)
Protoxodon clemens Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894); Scott (1912)
Protoxodon henseli Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894); Scott (1912)
Protoxodon speciosus Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1891b, 1894); Scott (1912)
Adelphotherium lutarium Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894); Scott (1912)
Adelphotherium repandum Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894); Lydekker (1894); Scott (1912)
Adelphotherium trivium Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894); Lydekker (1894); Scott (1912)
Adelphotherium rothi Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894); Scott (1912)
Adelphotherium pumilum Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894); Scott (1912)
Acrotherium intermedium Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894); Scott (1912)
Acrotherium mutabile Mercerat, 1891	*Adinotherium ovinum*	Scott (1912)
Acrotherium patagonicum Mercerat, 1891	*Nesodon imbricatus*	Ameghino (1894)
	Nesodon conspurcatus	Scott (1912)
Acrotherium variegatum Mercerat, 1891	*Nesodon imbricatus*	Scott (1912)

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HISTORY OF THE PALEOBOTANICAL COLLECTIONS OF THE MUSEO DE LA PLATA DURING THE 19TH AND 20TH CENTURIES

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Abstract. Two collections are housed in the División Paleobotánica of the Museo de La Plata, one of megafossils and the other of microscopic preparations. Both are nationally and internationally recognized. The collections began modestly with the fossil plants collected by Santiago Roth in the late 19th and early 20th centuries. From 1933, it had a great development with the donation of the personal collection of Joaquín Frenguelli. During the 1930s, 1940s, and 1950s, the materials housed in the division acquired world renown thanks to the work of Frenguelli, fundamental in the knowledge of the flora of Gondwana. However, the División Paleobotánica did not exist at that time. In the 1960s when, with Sergio Archangelsky as chief, it became independent. As the Museo de La Plata is a university museum, since the middle of the 20th century, the collections have maintained a very close relationship with the educational field, both because of the objects that are used as teaching material and because of the people who have carried out theses, internships, and scholarships in the division. The objects of the collections served for the undergraduate training of the students who later, during their postgraduate studies, incorporated many specimens into the collection. In this way, the institution's relationship with university education functioned as a positive feedback process that made the collections grow significantly and continuously into the early 21st century.

Key words. Fossil plants. Facultad de Ciencias Naturales y Museo. Roth. Frenguelli. Archangelsky. Artabe.

Resumen. HISTORIA DE LAS COLECCIONES DE PALEOBOTÁNICAS DEL MUSEO DE LA PLATA DURANTE LOS SIGLOS XIX Y XX. En la División Paleobotánica del Museo de La Plata se resguardan dos colecciones, una de megafósiles y otra de preparados microscópicos. Ambas son reconocidas a nivel nacional e internacional. Las colecciones comenzaron de forma modesta con las plantas fósiles recolectadas por Santiago Roth a fines del siglo XIX y principios del siglo XX. A partir de 1933, tuvo un gran desarrollo con la donación de la colección personal de Joaquín Frenguelli. Durante las décadas de 1930, 1940 y 1950, los materiales alojados en la división adquirieron renombre mundial gracias a los trabajos de Frenguelli, fundamentales en el conocimiento de la flora de Gondwana. Sin embargo, para ese entonces, la División Paleobotánica no existía como tal. Fue en la década del 1960 cuando, con Sergio Archangelsky como jefe, se independizó. Al ser el Museo de La Plata una institución universitaria, las colecciones mantienen desde la mitad del siglo XX una vinculación muy estrecha con el ámbito educativo, tanto por los objetos que son empleados como material didáctico como por las personas que han realizado trabajos de tesis, pasantías y becas en la división. Los objetos de las colecciones servían para la formación de grado de los estudiantes que luego durante sus estudios de postgrado incorporaban una gran cantidad de ejemplares a la colección. De esta manera, la relación de la institución con la educación universitaria funcionó como un proceso de retroalimentación positiva que hizo crecer las colecciones de manera significativa y continua hasta principios del siglo XXI.

Palabras clave. Plantas fósiles. Facultad de Ciencias Naturales y Museo. Roth. Frenguelli. Archangelsky. Artabe.

The División Paleobotánica is a department of the Museo de La Plata (Buenos Aires Province, Argentina) focused on the study of fossils of plants, algae, and fungi (Fig. 1.1–1.2). First, this section was part of the Sección Paleontología, created a few years after the museum's foundation, between 1889 and 1895 (Teruggi, 1994; Lanteri, 2021). It was not until the 1960s that the División Paleobotánica functioned as an independent division from the rest of the museum's paleontological disciplines (Morel *et al.*, 2015).

Currently, the division houses two collections (Fig. 1.3–1.9), which preserve thousands of fossils of plants, algae, and fungi from localities worldwide. The oldest collections consists of macroscopic specimens, while the newest comprises microscope slide preparations of fossil woods, leaf cuticles, and pollen/spores, among others. The former holds *ca.* 16,000 pieces and the latter *ca.* 1,600 pieces (Fig. 1.4–1.9). On the whole, they include samples from 28 countries (Argentina, Austria, Bolivia, Brazil, Canada, Chile,

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Figure 1. 1, Front view of the Museo de La Plata. **2,** Corridor of level 0 of the Museo de La Plata, where the collections of the División Paleobotánica are located. **3,** Door of the former "Parodi" classroom, where the largest part of the megafossil collection of the División Paleobotánica is currently housed. **4,** Furniture of the megafossil collection. **5–6,** Inside of the drawers where the megafossil collection specimens are housed. **7–8,** Furniture of the microscopic slide collection. **9,** Trays with microscopic slides.

China, Czech Republic, Egypt, England, France, Germany, Ireland, Italy, Japan, Norway, Peru, Poland, Russia, Scotland, Somalia, South Africa, Spain, Sweden, Tanzania, Uruguay, USA, and Venezuela) and 16 provinces of Argentina (Buenos Aires, Catamarca, Córdoba, Chubut, Entre Ríos, La Rioja, Mendoza, Neuquén, Río Negro, Salta, San Juan, San Luis, Santa Cruz, Santa Fe, Tierra del Fuego, Antártida e Islas del Atlántico Sur, and Tucumán). The materials correspond to stromatolites, fungi, calcareous algae, bryophytes, lycophytes, sphenophytes, ferns, seed ferns, cordaitaleans, ginkgoaleans, conifers, and flowering plants, ranging from Proterozoic to Holocene ages.

These collections are recognized at both national and international levels. However, their history is intricate to reconstruct due to certain divisions' instabilities and the incomplete records of material entry. In this work, we revisited the history of the paleobotanical collections at the Museo de La Plata and analyzed how they developed during the 19th and 20th centuries, as well as their relationship with the activities integrated into the museum, including undergraduate and graduate education.

ORIGINS OF THE COLLECTIONS

At the end of the 19th and the beginning of the 20th centuries, the paleobotanical collections of the Museo de La Plata began modestly with the fossil plants collected by Kaspar Jacob Roth (1850–1924), also known as Santiago Roth, who was chief of the Sección Paleontología between 1895 and 1906 (Fig. 2.1–2.2) (Bond, 1998a; Riccardi, 2011). This position allowed Roth to carry out numerous geological, paleontological, and hydrogeological works in different parts of the country, in addition to acting as an expert for Argentina in the border issue with Chile (Bond, 1998a; Riccardi, 2011). Roth (1899) mentioned the presence of silicified wood in levels corresponding to the Upper Cretaceous of Patagonia in its "strata with dinosaurs". Some of these woods are housed in the megafossil collection. Roth also collected Jurassic leaf impressions from Sierra Pintada, Neuquén Province, which were later studied by Kurtz (1902) (Fig. 2.3–2.5). In paleobotanical studies, Federico Kurtz (1854–1921), the founder of this discipline in Argentina, produced his first works at the Museo de La Plata (Bondesio, 1977).

When the museum was nationalized in 1906 and became part of the Universidad Nacional de La Plata, Roth also became professor of paleontology. In 1915, Eduardo Carette (1886–1946) joined as associate professor of the same discipline (del Ponte, 1947; García, 2004; Riccardi, 2011).

In 1921, the Sección Paleontología was divided into two independent sections, one dedicated to invertebrates and plants (in charge of Carette) and the other dedicated to vertebrates (in charge of Roth). However, Carette's relationship with the museum lasted only a short time and the two sections were reunited two years later (Riccardi, 2011).

When Roth died in 1924, the fossil plant collections were again part of the Departamento Paleontología, which was in charge of Ángel Cabrera y Latorre (1879–1960) (Bond, 1998b). Cabrera was the chief from 1925 until 1934, when the department was finally divided into the División Paleozoología Invertebrados-Paleobotánica and División Paleozoología Vertebrados. At that time, the collections comprised nearly 860 specimens from the country and abroad. Among them, it is worth mentioning the fern and gymnosperm fossil leaves from the Jurassic of Piedra Pintada collected by Roth (Neuquén Province, Argentina), the stromatolites from the Paleocene of General Roca (Río Negro Province, Argentina) whose collector is unknown, and the angiosperm fossil leaves from the Cretaceous of Cerro Guido (Chile) brought by Rodolfo Hauthal (1854–1928).

THE COLLECTION OF DIVISIÓN PALEOZOOLOGÍA DE INVERTEBRADOS-PALEOBOTÁNICA

In 1934, the Italian physician and naturalist Joaquín Frenguelli (1883–1958) joined the museum, first as secretary and then as director between 1935 and 1946. Until then, Frenguelli worked at the Universidad del Litoral (Santa Fe) and attributed 124 publications on geology, paleobotany (especially diatoms), and stratigraphy, among others. One of his first decisions was to divide the paleontology area into two divisions: Paleozoología Vertebrados, headed by Ángel Cabrera (1934–1947) (Bond, 1928b) and Paleozoología Invertebrados-Paleobotánica, supervised by him.

The work of Frenguelli was crucial to give a renewed

impetus to the collections of fossil invertebrates and plants. He donated his collection, which consisted of 1,908 boxes with 6,000 specimens of fossil invertebrates and plants and 2,000 microscopic slides of fossil and living diatoms (Teruggi, 1994; Riccardi, 2011). The microscopic slides were later transferred to the División Ficología of the Museo de La Plata, while *ca.* 1,440 pieces from Frenguelli's boxes were given to the División Paleobotánica (Fig. 3.1).

Figure 2. 1, Fossil wood found by Roth, Carette, and Schiller, incorporated in the beginnings of the División Paleobotánica collections (near 1921), with the label used in the 1930s and 1940s, **LPPB 7747**. Scale bar= 2 cm. **2,** Original label of the fossil wood from Figure 2.1., with information about its provenance and date of collection. **3,** A fossil leaf of "***Thinnfeldia***" (=***Scleropteris vincei***) collected by Roth, with its original label, **LPPB 4283**. Scale bar= 1 cm. **4,** A fossil leaf of ***Dictyophyllum*** (=***Clathropteris kurtzi***) collected by Roth, with its original label, **LPPB 4285**. Scale bar= 2 cm. **5,** Plate modified from Kurtz (1902), in which the specimens from Piedra Pintada collected by Roth were studied. The drawing with number 3 corresponds to the specimen from Figure 2.3, while the illustration with number 5 corresponds to the specimen from Figure 2.4. Scale bar= 2 cm.

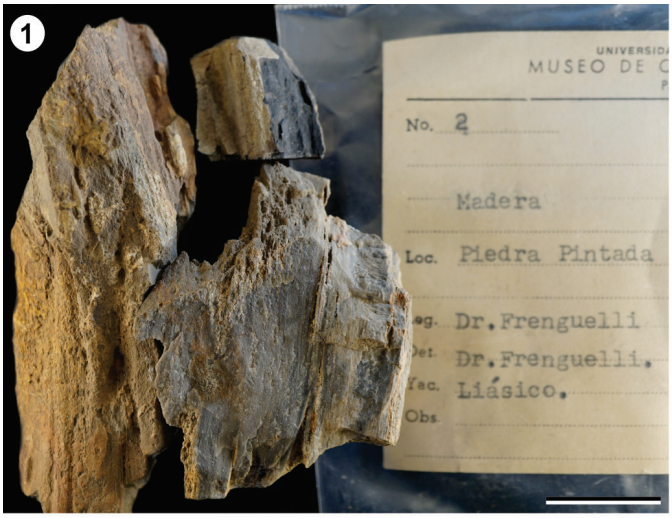
Frenguelli methodically identified and incorporated *ca.* 500 specimens that entered the museum before his arrival (Fig. 3.2–3.3). He began a new cataloging system with alphabetical, systematic, geographic, and stratigraphic files, which complemented the entry book (Morel *et al.*, 2015). This cataloging system did not include the year of collection, entry, and determination of the material (Fig. 3.4). This information was only available through the memoirs that Frenguelli published periodically in the journals of the Museo de La Plata (Frenguelli, 1935; Frenguelli & Tribiño, 1936, 1937, 1938, 1939, 1940, 1941, 1943, 1944, 1945). Compared to other divisions, the work of the División Paleozoología Invertebrados-Paleobotánica, during the period in which Frenguelli was its director, was limited by the scarcity of time, since he was also the director of the museum. Another inconvenience was that the division had scarce staff, which consisted of only one preparation technician and one volunteer, in addition to the division chief. The volunteer was the geologist Armando Leanza (1919–1975), who began to collaborate in the fossil invertebrates' section in 1941. Two years later, he was named a section manager, but in 1944, he retired from this position and the division.

Between 1934 and 1955, approximately 2,000 pieces were registered, collected during fieldwork made by Frenguelli and, on several occasions, accompanied by his disciple Héctor Orlando (*ca.* 1918–?) (Fig. 3.5, 3.7). Among these pieces the stromatolites from the Cretaceous of Salta Province, 12 boxes with materials from the Jurassic of Neuquén Province and the Eocene of Chubut Province, and numerous specimens from the Carboniferous of La Rioja Province and the Permian of Chubut Province stand out. Furthermore, Frenguelli described and determined more than 700 samples, which other people donated. They comprise, for example, fossils from the Paleogene–Neogene of Pichi Leufú (Río Negro Province) and Laguna del Hunco (Chubut Province) brought by Rodolfo Maldonado Bruzzone (*ca.* 1900–1975; Fig. 3.6); the Permian of various localities of Chubut Province provided by Alejandro Piatnitzky (1879–1959); the Jurassic of Puesto C. Meschio (Chubut Province) by Tomás Suero (1915–1963); the Paleogene of Río Turbio (Santa Cruz Province), donated by José Brandmayr (?–1953); the Jurassic of Cerro Madre e Hija (Santa Cruz Province) by Franz Mansfeld (?–?); the Carboniferous of Caballo del Anca (La Rioja Province) by Horacio Harrington (1910–1973); and the Triassic of Uspallata (Mendoza Province) by Félix Rodrigo (*ca.* 1928–?) (Frenguelli, 1953; Rolleri, 1964). Also during this time, materials were added through exchange with other institutions, among which it is worth mentioning 14 pieces of the Cretaceous of North America from the Royal Ontario Museum. By 1943, the collection of the division had reached 10,000 specimens, including fossil plants and invertebrates. In 1955, when Frenguelli left his position definitely, it is calculated that *ca.* 5,000 fossil plant specimens were part of the collection. Approximately 3,000 of these materials were identified by Frenguelli himself, but despite his enormous effort, *ca.* 1,400 pieces were just assigned to taxa by subsequent researchers, and at least 600 specimens remain undetermined to this day.

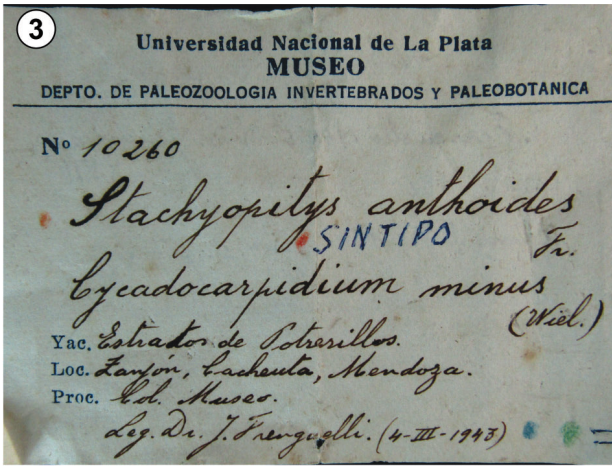
During the 1930s, 1940s, and 1950s, the materials housed in the division gained world renown through the work of Frenguelli, who pioneered the knowledge of the evolution of the Gondwanan flora. He published more than 270 scientific research and teaching papers.

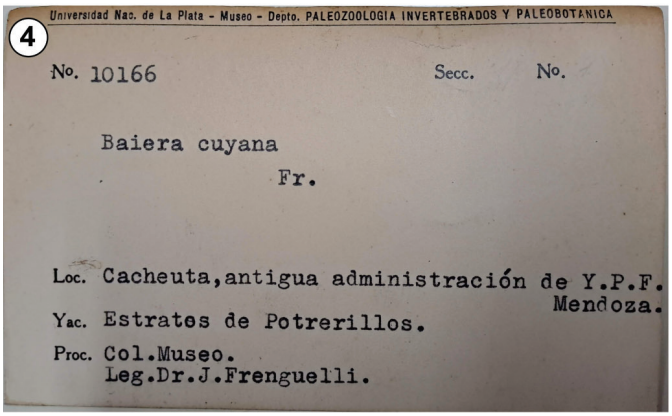
In parallel, Frenguelli began the modernization of the exhibition rooms dedicated to fossil plants and invertebrates. Regarding paleobotany, he was responsible for the restoration of the fossil trunk pedestals and the assembly of display cases dedicated to "problematic fossils" and algae,

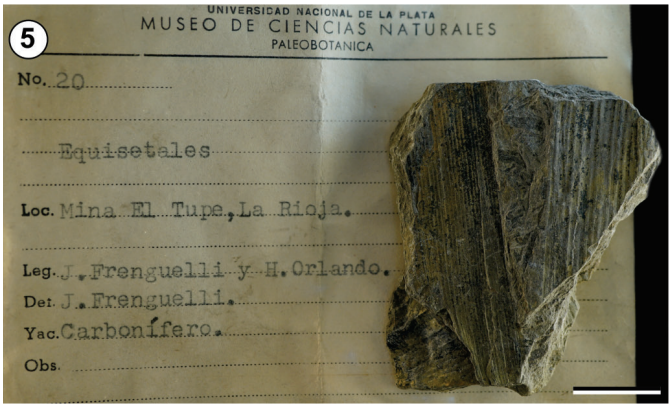
Figure 3. 1, Fossil wood which belonged to the personal collection of Frenguelli, **LPPB 2**. Scale bar= 2 cm. **2,** Fossil reproductive structure determined as ***Stachyopitys anthoides*** by Frenguelli, **LPPB 10260**. Scale bar= 0.5 cm. **3,** Label of specimen from Figure 3.2, the legend "*Col. Museo*" indicated that it was entered before Frenguelli arrived at the division. **4,** File from the Frenguelli's cataloging system. **5,** Sphenophyte stem found during fieldwork by Frenguelli and Orlando in the Carboniferous of La Rioja Province, **LPPB 20**. Scale bar= 1 cm. **6,** Angiosperm fossil leaf "***Lomatites occidentalis***" from the Eocene of Chubut Province, brought by Maldonado Bruzzone and determined by Frenguelli, **LPPB 2531**. Scale bar= 2 cm. **7,** ***Lithothamnium*** (calcareous alga) from the Holocene of Chubut Province, found during fieldwork by Frenguelli, **LPPB 5113**. Scale bar= 4 cm. **8,** Exhibition case with araucarian cones and trunks from Cerro Madre e Hija mounted in 1935. The photograph was taken from Frenguelli & Tribiño (1936), used under Creative Commons license CC BY-NC-SA 4.0 DEED.

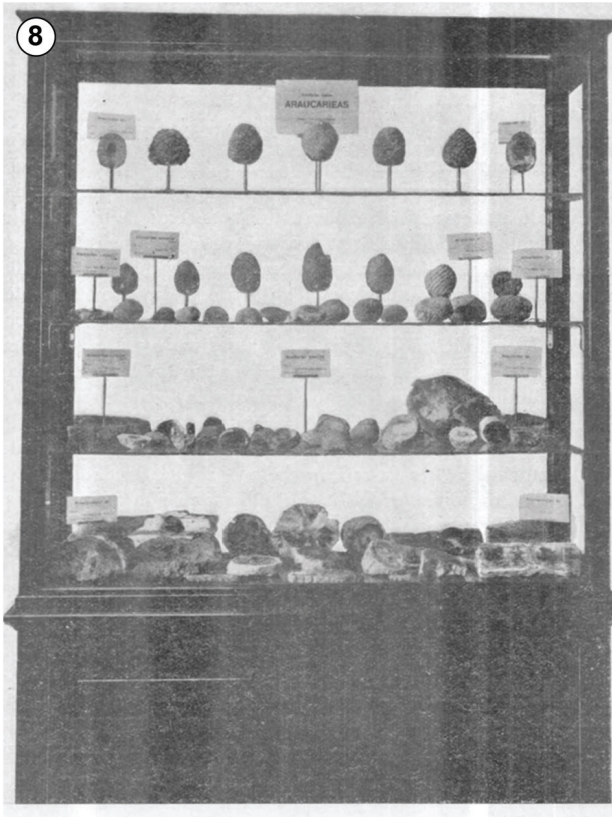

1
MUSEO DE C
No. 2
Madera
Loc. Piedra Pintada
Leg. Dr. Frenguelli
Det. Dr. Frenguelli.
Yac. Liásico.
Obs.

2


3
Universidad Nacional de La Plata
MUSEO
DEPTO. DE PALEOZOOLOGIA INVERTEBRADOS Y PALEOBOTANICA
Nº 10260
Stachyopitys anthoides Fr.
SINTIPO
Cycadocarpidium minus (Wiel.)
Yac. Estratos de Potrerillos.
Loc. Zanjón, Cacheuta, Mendoza.
Proc. Col. Museo.
Leg. Dr. J. Frenguelli. (4-III-1943)


4
Universidad Nac. de La Plata - Museo - Depto. PALEOZOOLOGIA INVERTEBRADOS Y PALEOBOTANICA
Nº. 10166
Secc.
Nº.
Baiera cuyana
Fr.
Loc. Cacheuta, antigua administración de Y.P.F.
Mendoza.
Yac. Estratos de Potrerillos.
Proc. Col. Museo.
Leg. Dr. J. Frenguelli.


5
UNIVERSIDAD NACIONAL DE LA PLATA
MUSEO DE CIENCIAS NATURALES
PALEOBOTANICA
No. 20
Equisetales
Loc. Mina El Tupe, La Rioja.
Leg. J. Frenguelli y H. Orlando.
Det. J. Frenguelli.
Yac. Carbonífero.
Obs.


8
ARAUCARIEAS

6

7

angiosperms from the Laguna del Hunco (Chubut Province), seed ferns, and araucarian cones and trunks from Cerro Madre e Hija (Santa Cruz Province) (Fig. 3.8).

At the end of the 1940s, the museum became a faculty of the Universidad Nacional de La Plata, which was named Facultad de Ciencias Naturales y Museo. Therefore, it attained a greater emphasis on education. In 1946, the faculty and the museum were intervened and Frenguelli presented his resignation from all his positions, which was accepted in February 1947 by the new director Emiliano Mac Donagh (1896–1961, director between 1946 and 1949) (Bondesio, 1977; Teruggi, 1981; Riccardi, 2013). From 1953 to 1955, Frenguelli returned to the museum and resumed his research in the División Paleozoología Invertebrados-Paleobotánica (Lanteri, 2021).

After Frenguelli, different people succeeded each other as division head; most were professors of paleontology courses, who marginally dealt with aspects related to the collections (Riccardi, 2011). In 1947, Armando Leanza assumed as the division leader, but he resigned in 1948, and subsequently the museum director Mac Donagh took over this position. It was not until 1950 that Orlando was appointed professor and designated as the new division chief. He specialized in paleobotany and kept the collections within the guidelines established by Frenguelli. Orlando remained in his position until 1955, when the museum was again intervened, and Fernando Márquez Miranda (1897–1961) took over as director (Lanteri, 2021). There is no record of who took charge of the division from 1955 to 1958.

Between 1958 and 1961, Pedro N. Stipanicic (1921–2008), a specialist in paleobotany and biostratigraphy of the Argentine Mesozoic and professor of paleobotany, was division head. Horacio H. Camacho (1922–2015), a specialist in Cenozoic invertebrates and professor of the course "*Paleontología de Invertebrados*" (Invertebrate Paleontology), succeeded Stipanicic between 1961 and 1966. Both Stipanicic and Camacho devoted most of their time at the institution to teaching (Riccardi, 2011). Therefore, the growth of the collections was somewhat halted compared to the time of the Frenguelli and Orlando directorships.

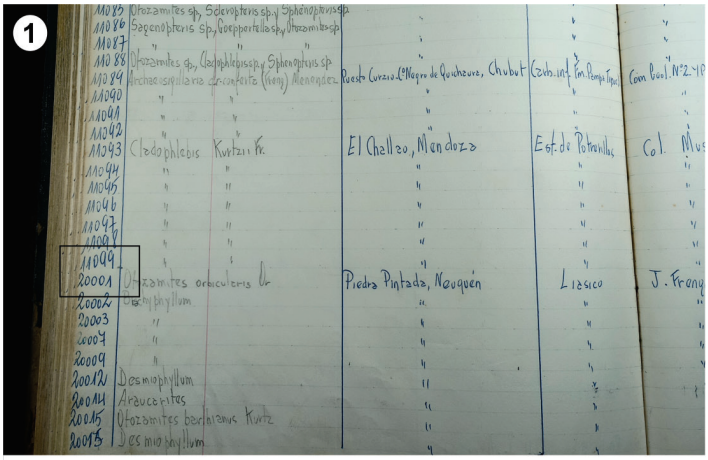
THE COLECTIONS OF THE DIVISIÓN PALEOBOTÁNICA

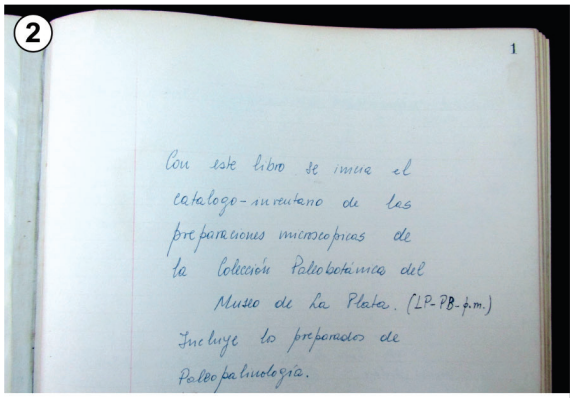
In 1957 it was decided to divide the División Paleozoología Invertebrados-Paleobotánica into two independent divisions. However, this separation did not take place until 1966, when Arturo J. Amos (1927–1999) was appointed chief of the División Paleozoología Invertebrados and Sergio Alchangelsky (1931–2022) as head of the División Paleobotánica (Riccardi, 2011; Morel *et al.*, 2015).

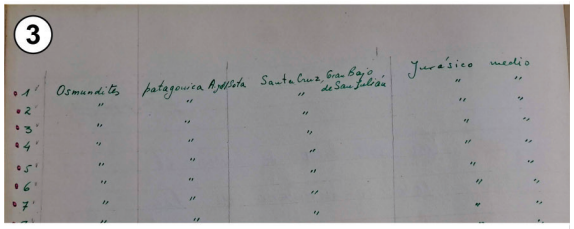
Archangelsky's management brought profound positive changes to the paleobotanical collections. The megascopic specimen collection was reorganized and given the acronym LPPB (*La Plata-Paleobotánica*). In this rearrangement, the specimens kept the original numbers given to them at the time of the División Paleozoología Invertebrados-Paleobotánica. For this reason, the collection numbers did not follow a chronological order and there were spaces in the numbering. For example, specimens between 276 and 278 were entered in the 1960s; while materials from 20,766 to 20,774 were entered in the 1940s. In addition, there were no specimens with numbers between 11,099 and 20,000 until 1996 (Fig. 4.1).

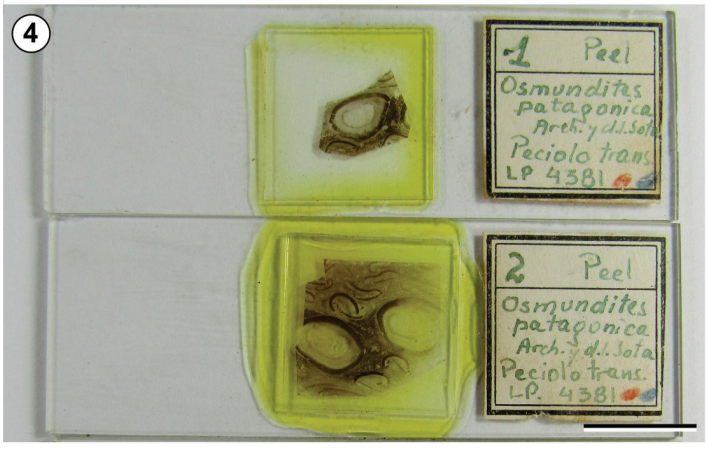
Archangelsky also started the microscopic collection with the acronym LPpm (*La Plata-preparado microscópico*) (Fig. 4.2–4.4). This collection houses microscopic slides of permineralized stems and woods, fossil leaf cuticles, and fossil palynomorphs. In the same year that Archangelsky took over the direction of the División Paleobotánica, the

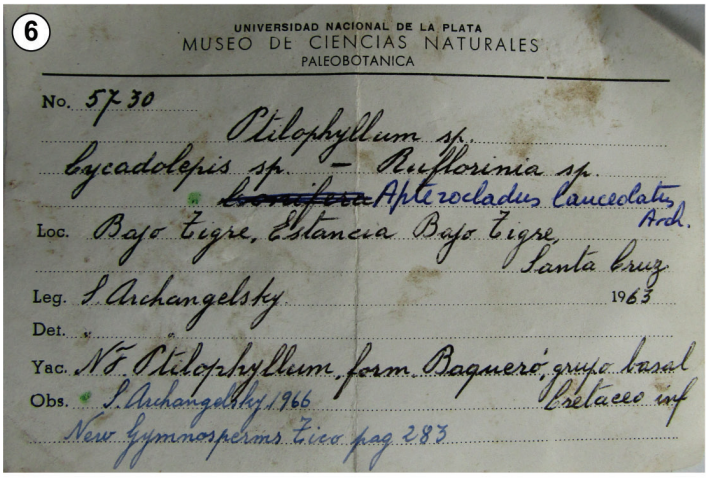
Figure 4. 1, Page from the entry book of the collection of megafossils, in which it is indicated with a box that there was discontinuous numbering of the pieces prior to the arrival of Archangelsky as division chief. **2–3,** First pages from the entry book of the collection of microscopic slides. **4,** Peel of ***Osmundites patagonica*** stem, which were between the first slides being incorporated to the collection, **LPpm 1–2**. Scale bar= 1 cm. **5,** Several specimens of ***Pararaucaria patagonica*** cones and "***Araucarites sanctaecrucis***" branches and cones, from the Jurassic of Santa Cruz Province, collected and determined by Archangelsky. **LPPB 6106, 6097, 6119, 6110, 6112, 6115, 6113, 6111, 6105, 6019, 6117, 6121, 6126, 6118, 6122, 6116** (from left to right and from top to bottom). Scale bar= 2 cm. **6–7,** Collection label and sample with leaves of ***Ptilophyllum***, ***Ruflorinia***, and ***Apterocladus*** from the Early Cretaceous of Santa Cruz Province found and determined by Archangelsky, **LPPB 5730**. Scale bar= 2 cm. **8,** Part and counterpart of an impression of ***Neuropteris*** cf. ***clarksonii*** from the Carboniferous of Mazon Creek**, LPPB 7593.** Scale bar= 2 cm.


Otozamites sp., Sclerophyllum sp., Sphenopteris sp.
Sagenopteris sp., Coeppertella sp., Otozamites sp.
Otozamites sp., Cladophlebis sp., Sphenopteris sp.
Cladophlebis Kurtzii Fr.
El Challao, Mendoza
Piedra Pintada, Neuquén
Otozamites orbiculatus Br.
Desmiophyllum
Desmiophyllum
Araucarites
Otozamites barlaeanus Kurtz
Desmiophyllum


1
Con este libro se inicia el catalogo-inventario de las preparaciones microscopicas de la Coleccion Paleobotanica del Museo de La Plata. (LP-PB-p.m.)
Incluye las preparados de Paleopalinologia.


Osmundites patagonica Archiata
Santa Cruz
Jurásico medio


1 Peel
Osmundites patagonica
Arch. y d.l. Sota
Peciolo trans.
LP 4381
2 Peel
Osmundites patagonica
Arch. y d.l. Sota
Peciolo trans.
LP 4381


UNIVERSIDAD NACIONAL DE LA PLATA
MUSEO DE CIENCIAS NATURALES
PALEOBOTANICA
No. 5730
Ptilophyllum sp.
Cycadolepis sp. – Ruflorinia sp.
Apterocladus lanceolatus Arch.
Loc. Bajo Tigre, Estancia Bajo Tigre
Santa Cruz
Leg. S. Archangelsky 1963
Det.
Yac. N° Ptilophyllum, form. Baguerá, grupo basal
Cretáceo inf.
Obs. S. Archangelsky 1966
New Gymnosperms Tico pag 283

palynologist Juan C. Gamerro (1923–2013) joined the staff, and the palynology laboratory, focusing on both fossil and extant palynomorphs, began to function in the same division.

Like Frenguelli, Archangelsky substantially improved the megascopic collection by incorporating nearly 2,500 specimens collected by himself, in some cases together with other renowned paleobotanists such as Carlos Menéndez (1921–1976) and Rafael Herbst (1936–2017). Among these materials, it is worth highlighting the 2,200 samples from the Middle Jurassic and Early Cretaceous of Santa Cruz Province (Fig. 4.5–4.7) and 150 fossils from the Jurassic of Yorkshire (Great Britain). On the other hand, during his tenure he studied and identified approximately 3,000 fossils previously entered or donated. On occasions, he conducted this labor together with Elías De La Sota (1932–2013), Rafael Herbst, and Oscar Arrondo (1936–1992). Other outstanding pieces which were entered in that period came from the Upper Carboniferous of various basins in Spain (La Magdalena-León, Ciñera-Matallane, among others), the Permian of China, and the Triassic of South Africa through donations; and several pieces from the Carboniferous Mazon Creek fossil beds (Illinois, USA) were exchanged with the Field Museum of Natural History (Fig. 4.8).

Regarding university education, Archangelsky was the first professor of the course "*Paleobotánica*" (Paleobotany), where he incorporated many specimens from the division's collections as teaching material. Likewise, he published a textbook titled "*Fundamentos de Paleobotánica*" (Archangelsky, 1970), a reference for several undergraduate subjects of the Facultad de Ciencias Naturales y Museo and other faculties in the country. This book was illustrated with numerous photographs of specimens from the division's collections.

In 1976, Archangelsky and Gamerro left the Museo de La Plata and from that year on, Arrondo was the new chief of the division. With Gamerro's departure, the palynological studies were almost interrupted. Arrondo, together with Bruno Petriella (1943–1984), continued research and teaching in paleobotany, the enrichment of the collections, and the training of Ph.D. students (Morel *et al.*, 2015; see "Relationship of the collections with the educational field" section below). In particular, Petriella promoted a discipline known as xylology (*i.e.*, the study of stem and wood anatomy) which was not yet developed in the museum. With this purpose, he started a didactic xylotheque of extant woods, with macroscopic and microscopic samples. At the same time, he added numerous pieces to the division collections, which he analyzed in his doctoral thesis (from the Paleogene of Cerro Bororó, Chubut Province) and subsequent contributions. Unfortunately, after Petriella's untimely death in 1984, the xylotheque began to deteriorate and become disorganized and never acquired the character of a formal repository.

The income of specimens through donations and exchange decreased considerably at the end of 1970. From that moment, the materials arrived mainly from fieldwork carried out by the museum and faculty staff. Approximately 1,400 pieces were incorporated in the 1970s and 1980s, mainly from the Triassic of central-western Argentina and the Triassic, Jurassic, and Paleogene of Argentine Patagonia.

Regarding the exhibitions, during the 1970s and 1980s, a reorganization of the rooms dedicated to paleontology was carried out (Teruggi, 1994), which remained almost unchanged until the beginning of the 21st century. Several pieces of the collection were displayed at renewed display showcases, among which can be mentioned those dedicated to the Carboniferous–Permian Gondwanan flora in exhibition room III (Fig. 5.1), the Triassic flora of Ischigualasto (San Juan Province) with large *Rhexoxylon* trunks in exhibition room IV (Fig. 5.2), the Cretaceous fossil plants from Baqueró, Santa Cruz Province in exhibition room V, and the Paleogene fossil stems from Cerro Bororó (Chubut Province) in exhibition room VIII. While preparing the pieces for the exhibition, several of them underwent alterations to emphasize the fossils (Fig. 5.3).

In 1990, Arrondo took a leave of absence due to a painful illness that led to his death in 1992. Analía Artabe (1954) took over as head of the division and remained in charge until 2003. During this period, the division staff research mainly focused on the comprehensive study of the Triassic floras of Argentina, so that the collections by the end of the 20th century became the most important paleobotanical repository with the largest number of Triassic pieces in South America.

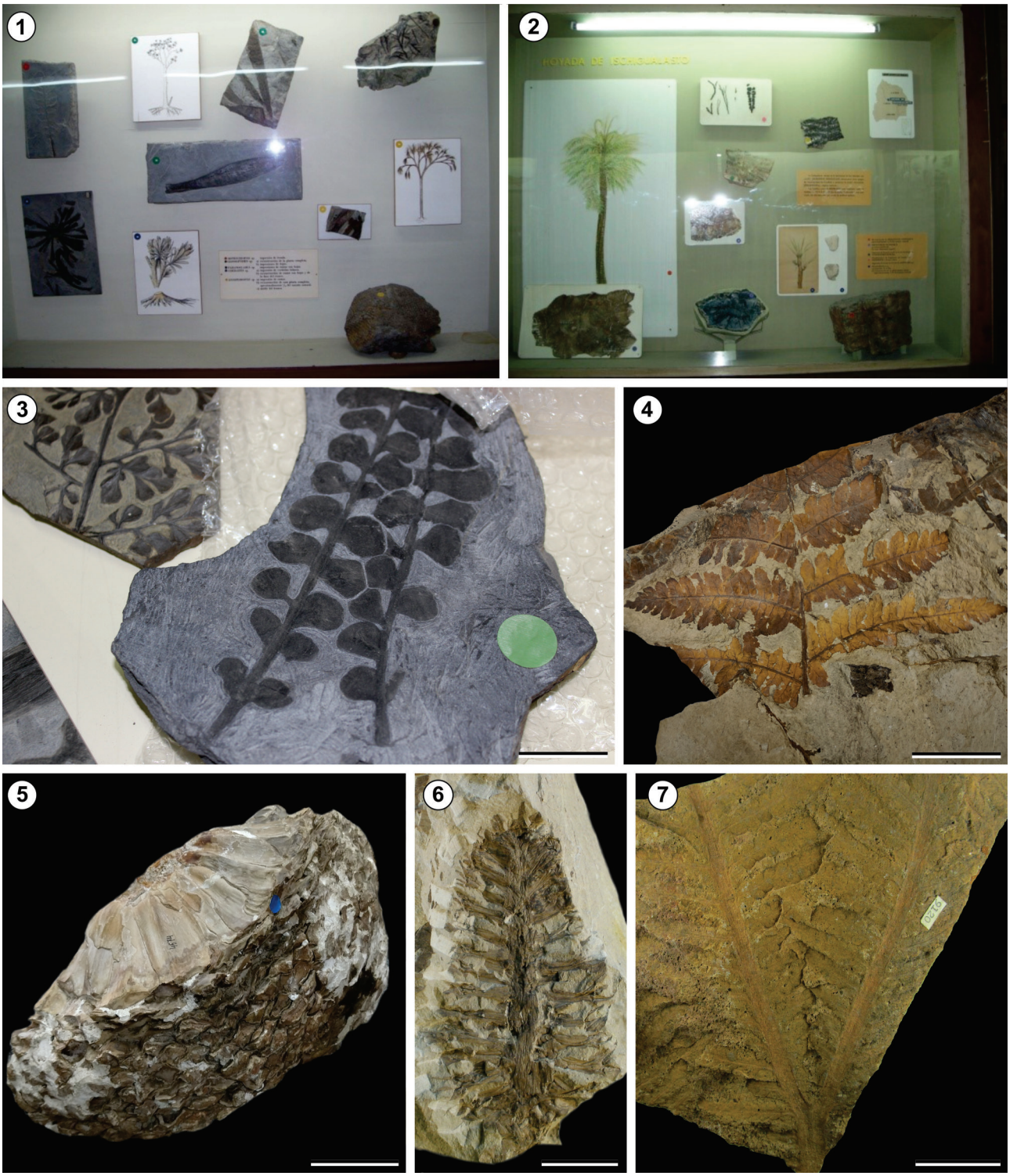


Figure 5. 1, Display case dedicated to the Carboniferous–Permian Gondwana flora in exhibition room III of the Museo de La Plata (from 1970s to 2003). **2,** Display case dedicated to the Triassic flora of Ischigualasto (San Juan Province) with large ***Rhexoxylon*** trunks in exhibition room IV (from 1970s to 2017). **3,** Pieces altered to highlight the fossil used in the exhibition. Scale bar= 2 cm. **4,** Fern leaf of ***Cladophlebis mendozaensis***, brought by Arrondo from the Triassic of La Juanita locality, Santa Cruz Province, **LPPB 14424**. Scale bar= 2 cm. **5,** Cycad stem of ***Bororoa andreisii*** studied by Petriella from the Paleogene of Cerro Bororó, Chubut Province, **LPPB 4574**. Scale bar= 4 cm. **6,** Conifer cone of ***Telemachus elongatus*** from the Triassic of Cerro Cacheuta, Mendoza Province, studied by Morel, **LPPB 11844**. Scale bar= 1 cm. **7,** Leaf of ***Zuberia zuberi*** from the Triassic of Los Menucos, Río Negro Province, studied by Artabe, **LPPB 9120**. Scale bar= 2 cm.

RELATIONSHIP OF THE COLLECTIONS WITH THE EDUCATIONAL FIELD

As the Museo de La Plata is a university museum, the collections have maintained a very close relationship with the educational field since the middle of the 20th century, both through the objects that are used as teaching material in classes and illustrations in textbooks, as well as through the people who have carried out theses, internships and scholarships in the division.

Regarding Ph.D. theses, Ernesto García (?–?), who studied the stratigraphy and tectonics of Southwestern Jáchal, San Juan Province, provided a collection with fossil plants of the Carboniferous period (García, 1945). Another geologist, Francisco R. Dara (?–?), developed his thesis under the supervision of Frenguelli and incorporated 30 pieces of fossil leaves and reproductive structures from the Carboniferous of San Juan Province (Dara, 1946; Frenguelli, 1946). Orlando and Norberto Traverso (?–?) completed their theses by studying fossil plants already housed in the division, although in the first case Orlando also provided dozens of new pieces (Orlando, 1946; Traverso, 1951).

Between 1969 and 1999, eight Ph.D. theses were developed in the División Paleobotánica. In all cases, the Ph.D. students reviewed existing material in the collection and incorporated new specimens resulting from their fieldwork. Arrondo focused on fossil plants from the Permian, Triassic, and Jurassic of the La Juanita locality, Santa Cruz Province, resulting in the addition of more than 300 new specimens to the collection (Arrondo, 1969; Fig. 5.4). Petriella contributed with approximately 200 macroscopic and microscopic samples of stems a wood from Cerro Bororó, Chubut Province (Petriella, 1971; Fig. 5.5). Edgardo Romero (1942–) focused on Eocene Río Turbio Formation palynology and provided several slides for the microscopic collection (Romero, 1973). Alicia Baldoni (1945–) mainly studied the fossil plants of the Lower Cretaceous of Patagonia, which Archangelsky had previously incorporated (Baldoni, 1977). During her thesis regarding the Los Menucos Triassic Flora, Artabe incorporated *ca.* 100 specimens of fossil stem, leaves, and reproductive structures (Artabe, 1984; Fig. 5.6). Eduardo Morel (1949–) provided more than 150 pieces of fossil bryophytes, sphenophytes, ferns, and gymnosperms from the Triassic of Cerro Cacheuta, Mendoza Province (Morel, 1991; Fig. 5.7). More than 40 macroscopic and microscopic samples of stems, leaves, and leaf cuticles were added by Alba Zamuner (1959–2012) from Ischigualasto, San Juan Province (Zamuner, 1992). The last thesis made during the 20th century in the division, whose materials were deposited in its collection, was that of Mariana Brea (1965–), who studied the Darwin Petrified Forest of Uspallata, Mendoza Province (Brea, 1995).

At the end of the 1960s, with the creation of the División Paleobotánica, the course of "*Paleobotánica*" (Paleobotany) was also established. To serve as study material for undergraduate students, a series of fossils were selected from the collections of the divisions. The didactic collection is currently housed in classrooms D3 and D4 of the Facultad de Ciencias Naturales y Museo and hosts megafossils and microscopic material. The megafossil collection has about 100 specimens, including pieces from the cherts, coal balls, leaf impressions and compressions, reproductive structures, and stems from Paleozoic and Mesozoic localities of Argentina, as well as from the Devonian, Carboniferous, and Eocene of North America and Europe. The Paleozoic specimens from abroad were acquired by the first professor of the course, Archangelsky, and later the didactic collection was nourished with samples representing the study topics of the division research group: Neopaleozoic of La Rioja and Chubut provinces, Triassic of San Juan and Mendoza provinces, Jurassic of Patagonia, and Eocene of Canada. The microscopic material comprises mostly sections of coal balls from the Carboniferous of the northern hemisphere, including anatomical sections of vegetative and reproductive organs of the most representative groups of that time. In addition, it is complemented by phytolith samples, wood sections, and palynological samples, mostly from Argentina. This collection is mainly used in paleobotany courses for botany and paleontology students, and other courses for geology and biology students.

In addition to the research work, the general and didactic collections have been enriched by the material deposited by students of geology and paleontology for their theses and doctoral dissertations. The objects of the collections were used for the undergraduate education of the students, who later, during their postgraduate studies, incorporated many specimens to the collection (Fig. 6).

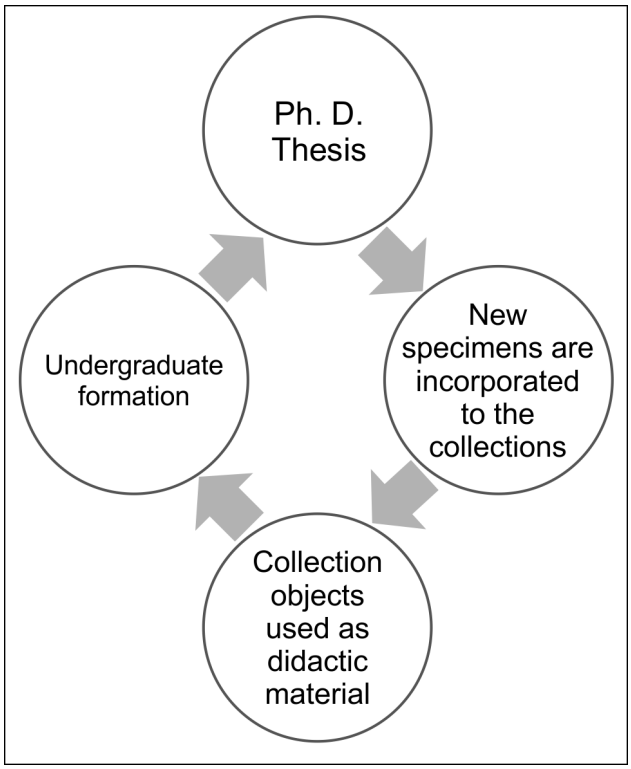


Figure 6. Scheme of the feedback process between the collections of the División Paleobotánica with the university education.

CONCLUSIONS

In the history of the paleobotanical collections of the Museo de La Plata during the 19th and 20th centuries, we can define five stages. The first stage spans from the end of the 19th century to 1934, when the materials were received without prior study, since the museum did not have a specialist in paleobotany. The second stage, from 1934 to 1955, when Frenguelli, as paleobotanist, enhanced the collections through his research and management. This period was characterized by a great diversity of ways of entering pieces: donations, fieldworks made by Frenguelli and other museum researchers, and Ph.D. theses. The third stage, between 1955 and 1966, was a time of standstill for the collections. From 1966, the fourth stage began with Archangelsky's management, when the plant fossil collections finally became segregated from the other fossil collections. From 1966 to 1976 was the period of modernization and strong reorganization. The fifth stage started with Archangelsky's departure in 1976, when the pieces incorporated by donation and exchange were gradually reduced. In this period (1976–2000), the new specimens were entered after their study and thus few lack a systematic classification.

It can be concluded that the institution's relationship with the university education functioned as a positive feedback process that made the collections grow significantly and continuously from the 1940s until the beginning of the 21st century.

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ASOCIACIÓN PALEONTOLÓGICA ARGENTINA

THE COLECCIÓN PALEONTOLOGÍA DE VERTEBRADOS LILLO, A PIONEERING ROLE IN THE RESEARCH ON FOSSIL VERTEBRATES IN ARGENTINA

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Abstract. Fossils collected by Abel Peirano from Catamarca and Tucumán in the late 1930s constituted the basis for the creation of the Colección Paleontología de Vertebrados Lillo (PVL) in Tucumán. The collection was formally founded in 1957 as Laboratorio de Vertebrados Fósiles (LVF) by Osvaldo Reig, who led many field trips that resulted in the publication and incorporation of emblematic materials from the South American Mesozoic. José Bonaparte became the director of the LVF in 1960, incorporating a large number of Mesozoic fossils from northwest Argentina, Cuyo, and Patagonia. These findings represented an enormous qualitative and quantitative leap in the knowledge of Mesozoic faunas from Gondwana. In 1979, when the LVF was dissolved and the fossil collection became known as PVL, Jaime Powell succeeded Bonaparte as curator and began leading field trips to the Cretaceous and Cenozoic of northwest Argentina and Cretaceous of northern Patagonia, incorporating important material in the collection. In the 1980s, young researchers began to work on fossils stored at the PVL, studying Neogene birds and mammals and Mesozoic archosauriforms and cynodonts. In the 1990s, other scholars under Powell's guidance focused their research on Cenozoic mammals, providing new and relevant material for the collection. Today the PVL has about 7,900 catalogued specimens (130 holotypes) and it represents one of the most important collections of vertebrate palaeontology in Argentina. In 2010, the collection was registered under the national authority on paleontological matters (Law 25.743) and became part of the Facultad de Ciencias Naturales-Instituto Miguel Lillo, Universidad Nacional de Tucumán.

Key words. Cenozoic. History. Mesozoic. Instituto Miguel Lillo. Northwest Argentina. Tucumán. Vertebrate paleontology.

Resumen. LA COLECCIÓN PALEONTOLOGÍA DE VERTEBRADOS LILLO, UN ROL PIONERO EN LA INVESTIGACIÓN SOBRE VERTEBRADOS FÓSILES EN ARGENTINA. Los fósiles colectados por Abel Peirano en Catamarca y Tucumán a fines de la década de 1930 constituyeron la base de la Colección Paleontología de Vertebrados Lillo (PVL). La colección fue fundada formalmente en 1957 como Laboratorio de Vertebrados Fósiles (LVF) por Osvaldo Reig, quien llevó a cabo importantes trabajos de colecta e investigación, resultando en la publicación e incorporación de material emblemático del Mesozoico sudamericano. José Bonaparte quedó a cargo del LVF en 1960, incorporando gran cantidad de fósiles mesozoicos del noroeste argentino, Cuyo y Patagonia, dando un enorme salto cualitativo y cuantitativo en el conocimiento de las faunas mesozoicas de Gondwana. En 1979, al disolverse el LVF y la colección comenzó a ser conocida como PVL, Jaime Powell sucedió a Bonaparte como curador y realizó numerosas campañas al Cretácico del noroeste argentino y norte patagónico, incorporando valioso material a la colección. En la década de 1980, jóvenes investigadores comenzaron a trabajar en el ámbito de la PVL estudiando mamíferos y aves neógenos y arcosauromorfos y cinodontes mesozoicos. Otros discípulos de Powell incorporados a partir de la década de 1990 centraron su investigación en mamíferos cenozoicos y aportaron novedosos y relevantes materiales. La colección PVL cuenta actualmente con unos 7.900 ejemplares (130 holotipos), representando una de las colecciones de vertebrados fósiles de mayor importancia de Argentina. En 2010 la colección fue registrada ante la Autoridad Nacional en Materia Paleontológica (Ley 25.743) a nombre de la Facultad de Ciencias Naturales-Instituto Miguel Lillo, Universidad Nacional de Tucumán

Palabras clave. Cenozoico. Historia. Mesozoico. Instituto Miguel Lillo. Noroeste argentino. Tucumán. Paleontología de vertebrados.

One of the most significant vertebrate paleontology collections in Argentina is the Colección Paleontología de Vertebrados Lillo (PVL), belonging to the Facultad de Ciencias Naturales e Instituto Miguel Lillo (FCN-IML),

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Universidad Nacional de Tucumán (UNT), Tucumán Province, Argentina. This collection is the most important in northern Argentina, housing about 7,900 specimens, including 130 holotypes, most of them from different regions of the country. The PVL is known worldwide for its exceptional fossils from the South American Triassic, in particular archosauromorphs and therapsids, many of them represented by holotypes. It is also notable for its Jurassic and Cretaceous dinosaurs and a precious assemblage of Paleogene, Neogene, and Quaternary mammals. The PVL is regularly visited by researchers from all over the world, particularly those who study Mesozoic archosaurs and therapsids. Here, we present a brief summary of the main events that marked the origin and development of this remarkable collection.

When the collection was created at the end of the 1950s, it was called *Laboratorio de Vertebrados Fósiles* (LVF) of the IML. The institute was named after Miguel Ignacio Lillo (1862–1931) (Fig. 1), one of the founding professors and researchers of the UNT. This self-taught Argentine scholar, who developed most of his career as a botanist, was a member of the well-known *Generación del Centenario* (Peña de Bascary, 2020), a celebrated group of intellectuals living in Tucumán Province 100 years after the independence of the country, who, among others things, founded the UNT. Lillo is, without any doubt, responsible for the deeply rooted dedication to natural sciences in Tucumán and it remains his legacy.

Today, there are two main institutions linked to natural sciences teaching and research in Tucumán Province, namely the FCN-IML, belonging to the UNT, and the Fundación Miguel Lillo (FML), which was created in 1931 and currently falls within the Argentine Ministry of Education (Fig. 2). Both institutions occupy the same building and although the PVL is formally part of the FCN-IML, both institutions have collaborated in many ways (funding field trips, provision of technical personnel, facility maintenance, services, etc.) to the creation and maintenance of the fossil collection.

The UNT was created by provincial law in 1914 during the government of Ernesto Padilla (1873–1951) and was elevated to National University status in 1921 (Aceñolaza, 2018). The presence of Miguel Lillo among the committee of authorities of the UNT was very important. He was appointed in 1915 as honorary director of the Museo de Historia Natural of Tucumán Province, founded in that year by a provincial law, which would exhibit samples of regional geology, paleontology, archaeology, minerals, flora, and fauna (Fig. 3) (Peña de Bascary, 2020). In 1925, Tucumán Governor Miguel Mario Campero (1880–1962) authorized the temporary transfer of the museum to a building belonging to the UNT. While the province retained exclusive ownership of its collections, materials, and facilities to be acquired in the future, the UNT was the custodian of the museum, yielding its executive and administrative management to Lillo. The different collections soon increased their patrimony thanks to field trips conducted by the museum

Figure 1. Precursors of the **PVL** collection. **1,** Miguel Ignacio Lillo, 1921 (1862–1931) (Photograph from the archive of the Museo Histórico Dr. Miguel Lillo y su tiempo, FML, free use); **2,** Abel Peirano, *ca.* 1950 (1896–1969) (from Aceñolaza, 2018).

Figure 2. 1, Front and entrance gate to the property of the **FML**; **2,** Statue of Miguel I. Lillo made in granite by the sculptor Roberto Fernández Larrinaga; **3,** Building of the **FCN-IML**, **UNT**.

staff and through the acquisition of natural history collections that were the property of Lillo (Alderete & Vaca, 2008). In 1927, Lillo donated a piece of land that he owned to the UNT for the construction of a definitive museum building and it opened to the public under his direction. It was organized as a scientific institute with several research sections: systematic botany, phytochemistry, zoology, archaeology, and paleontology (Alderete & Vaca, 2008) (Fig. 3). In 1931, after Lillo's death and in honour of his legacy, the IML was created, which included the scientific collections that Lillo himself had donated to the UNT, his library, and the land where the FCN-IML and the FML are currently located (Aceñolaza, 1989, 2018; Alderete & Vaca, 2008; Zaia, 2012; Abdala *et al.*, 2022). According to Alderete & Vaca (2008), in 1935 the Museo de Historia Natural comprised the Zoology, Botany, Archaeology, Mineralogy, Geology, and Paleontology sections.

Figure 3. Museo de Historia Natural of the **UNT**, *ca.* 1927, the main precursor of the **PVL** (photographs provided by the Archivo Histórico de la Universidad Nacional de Tucumán). **1,** Exhibition room of paleontology; **2,** Exhibition room of archaeology; **3,** Exhibition room of botany; **4,** Exhibition room of zoology.

THE ARRIVAL OF ABEL PEIRANO

At the request of Lillo, one of his disciples, the Argentine Abel Antonio Peirano (1896–1969; Fig. 1), began his activities at the UNT in 1930 as a museum employee, cataloging and determining minerals, rocks, and fossils from the collections. Peirano, born in Buenos Aires, completed his primary and high-school studies in Tucumán Province at the Colegio Nacional, where he was a student of Lillo. In 1919, he graduated as a pharmacist at the Universidad de Buenos Aires and in 1936 he was designated as director of the Instituto de Mineralogía y Geología (IMG) of the UNT, created at his request. Peirano carried out several fieldworks, related mainly to mining, in areas west of the Sierra del Aconquija and Cumbres Calchaquíes mountain ranges in Catamarca and Tucumán provinces (Aceñolaza, 2020). In some of these expeditions during 1939, Peirano prospected and collected fossils in the Santa María and El Cajón valleys. He collected a large number of fossil vertebrates (currently identified as Colección Peirano) and published a series of stratigraphic and paleontological contributions describing outcrops and fossils found in two localities in Catamarca Province (Caspinchango and El Cajón valley) and two in Tucumán Province (Salinas de Amaicha and Tiopunco) (Peirano, 1943, 1946). Most of the fossils reported by Peirano are mammals (xenarthrans, notoungulates, litopterns, caviomorph rodents) and turtles. These 570 specimens would be the basis of the future PVL and represented approximately half of the fossils collected by Peirano (the other half is at the Museo de Geología, Mineralogía y Paleontología of the Instituto de Geología y Minería, Universidad Nacional de Jujuy). The IMG also received the collections of minerals, rocks, and fossils from the Museo de Historia Natural, which led in 1939 to the creation of a paleontology section in the institute for the preparation, reconstruction, and determination of fossil materials, in addition to the elaboration of files and catalogs (Alderete & Vaca, 2008). Activities at the IMG practically stopped in 1946 when Peirano was transferred to San Salvador de Jujuy, Jujuy Province, to develop research and teaching in mineralogy and geology (Alderete & Vaca, 2008).

Figure 4. Osvaldo Alfredo Reig (1929–1992; the only one standing with glasses), the founder of the **LVF** and first curator of the vertebrate fossil collection (the future **PVL**), with colleagues from the **IML** in 1959 (from Aceñolaza, 2018).

OSVALDO REIG ARRIVES AT THE IML AND FOUNDS THE LVF

In 1953, the UNT created the Escuela Universitaria de Ciencias Naturales as an academic section of the IML, with the aim to create university careers in natural sciences (Aceñolaza, 2018). The creation of this institution (currently part of the FCN-IML) entailed the need of trained teaching staff. The Moroccan paleobotanist of Russian origin Sergio Archangelsky (1931–2022) was hired in 1955. He created and organized the paleobotanical collection of the IML and taught as well (Archangelsky, 2014). At request of Archangelsky, the IML hired the autodidact Argentine biologist Osvaldo Reig (1929–1992) to conduct teaching and research projects in vertebrate paleontology (Ponsá Fontanals, 2012; Farina, 2019; Abdala *et al.*, 2022) (Fig. 4).

At that time, the intervening authority of the IML, Carlos F. Cuenya, requested the rector of the UNT, Argentine Eugenio Flavio Virla (1913–1986), the appointment of Osvaldo Reig as *Profesor de Investigación del Departamento de Geología* (Research Professor of the Department of Geology) of the IML to organize the zoo-paleontology section and to teach Historical Geology and Paleontology II (the latter aimed at studying fossil vertebrates) for the Geological Sciences PhD program (see Supplementary Information, p. 1). Despite the lack of a formal academic degree, Cuenya justified the request based on Reig´s high scientific background, as he was already a renowned researcher with important articles on both living mammals and fossil vertebrates (*e.g.*, Reig, 1955a, 1955b, 1956, 1957;

Contreras & Giacchino, 2003; Ponsá Fontanal, 2012; Abdala *et al.*, 2022). Reig arrived at the IML in November 1957.

Reig's priority was to establish a relevant paleontological collection. In May 1958, he sent a note to the director of the IML, the Dutch entomologist Abraham Willink (1920–1998), suggesting the acquisition of an important fossil vertebrates collection offered by the renowned Argentine paleontologist Carlos Rusconi (1898–1969). Reig indicated that Rusconi's collection consisted mainly of Ensenadan mammals from the Buenos Aires Province, Puelchean vertebrates from Buenos Aires city and its surroundings, and mammals from the Sacanana Formation, Colhuehuapan of Chubut Province. In his note, Reig mentioned that the collection of Ensenadan mammals contained several holotypes and other remains already described in the literature and that the Puelchean fossils were the only known from this stage and representatives of the early Quaternary (see Supplementary Information, p. 2). The Colección Rusconi arrived at the LVF of the IML in August 1958 (see Supplementary Information, p. 3), consisting of about 1,300 specimens: fishes (124), amphibians (two), reptiles (two), birds (four), and mammals (670), including 42 holotypes and around 500 unidentified specimens (Tab. 1).

In May 1958, Reig insisted to the authorities on the urgent need to incorporate personnel into LVF, especially a technician for prospecting in the field and preparation of material in the laboratory, as well as two assistants for conditioning and cataloging the collection (see Supplementary Information, p. 4). He also noted the need for optical equipment, including a binocular magnifying glass and a *camera lucida* (see Supplementary Information, p. 5). Reig also acted as curator of the living amphibian collection of the IML (see Supplementary Information, p. 6).

The North American paleontologist Alfred Romer (1894–1973), from Harvard University, led a successful paleontological expedition at the Ischigualasto area, San Juan Province in 1958 (see Romer & Cox, 1962). This prompted Reig and the LVF to urgently organize a field trip to the same area (Bonaparte & Migale, 2015; Abdala *et al.*, 2022; Alcober & Martínez, 2022). This first expedition was organized by the Escuela de Ciencias Naturales and the FML in June 1958, financed by the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) and had the logistical support of the IML, as summarized by Reig´s annual report to the IML. In addition to some of Reig's students, to this first trip went Archangelsky, who took advantage of the trip to make botanical collections, the Argentine geologist Rogelio Bellmann from the Instituto de Geología y Minería of Jujuy Province, the renowned Argentine fossil preparator Galileo J. Scaglia (1915–1989), who was at the time director of the Museo Municipal de Ciencias Naturales de Mar del Plata (Buenos Aires Province, Argentina), the young Argentine technician and self-taught paleontologist José F. Bonaparte (1928–2020), director of the Museo Popular de Ciencias Naturales Carlos Ameghino in Mercedes (Buenos Aires Province, Argentina), and staff from the La Rioja section of the Comisión Nacional de Energía Atómica, who gave important logistical support such as two vehicles and field materials (see Supplementary Information, p. 7). The discovery of a huge number of Triassic therapsids and archosauromorphs led to the organization of a second longer field trip in the following year.

In a note dated August 1958 and addressed to the head of the Geology Department of the IML, the Argentine geologist Celestino Danieli (1920–1987), Reig insisted on the urgent hiring of a technician with experience, at least temporarily, for the preparation of the materials obtained, for their immediate study and publication, recommending Scaglia for that position (see Supplementary Information, p. 10).

The first annual report presented in December 1958 on the activities carried out by the LVF (see Supplementary Information, p. 7–9) highlighted and provided important details of the four field trips that took place in 1958 and the state of the collection at that time. Reig indicated the importance of organizing a proper fossil laboratory with all the necessary tools for preparation, as well as furniture for the growing collection. Reig pointed out that the personnel for these tasks in the laboratory consisted of himself and María Stella Cabezas, a student assistant from the *Cátedra de Paleontología*. According to the mentioned report, in 1958 four paleontological field trips for prospecting were carried out: 1) in Patagonia, between January 15th and February 28th to Miocene outcrops of Neuquén Province, in the Colloncuran levels of the Limay river valley and Eocene

deposits of the Chico river, and to the south of the Colhué Huapí lake, Cañadón Hondo, and Cañadón Vaca, in Chubut Province. Field trip members were Archangelsky and Scaglia; 2) to Ischigualasto, in June (see above); 3) to the Quebrada de Humahuaca, Jujuy Province, between September 21st and 28th. In this trip, R. Bellmann, G. J. Scaglia, and the students Juan Carlos Viera, M. S. Cabezas, and the German-born Rafael Herbst (1937–2017) participated. Herbst would be the first graduate in Geological Sciences from the UNT in 1959; 4) to the Las Conchas river ravine and Calchaquí valley, Salta, Tucumán, and Catamarca provinces, between December 3rd and 17th, to collect fossil amphibians and fish remains of possible Cretaceous age and recognize the stratigraphic units of the Santa María valley. Members of this trip were J. C. Viera and M. Ibañez, member of the Comisión Nacional de Energía Atómica, Salta sectional. Based on numerous specimens from this trip at Las Conchas ravine, near Alemanía, Salta Province, Reig described *Saltenia ibanezi* from the Las Curtiembres Formation (Reig, 1959). The holotype of this species, housed at PVL, corresponds to an impression and counter-impression of an almost complete skeleton.

In the annual report, Reig also referred to the state of the collection (see Supplementary Information, p. 8–9) with around 2,500 specimens of fossil vertebrates, mainly mammals, although the work of cataloging was still ongoing. The collection comprised as follows: around 100 specimens of Miocene mammals from the Colloncuran of the Limay river donated by Reig; over 1,300 specimens including numerous holotypes from the Miocene of Sacanana, Chubut Province, part of the Colección Rusconi; Eocene mammals from Patagonia; a large collection of mammals from the Pliocene of Chapadmalal, Buenos Aires Province; an important collection of Triassic tetrapods; a valuable set of Jurassic anurans found by Archangelsky in Santa Cruz Province; Plio–Pleistocene mammals referable to Uquian units; a large number of Cretaceous anurans from Salta Province, the first known for South America for this period; and an important collection of fossil casts donated by the Museo de La Plata. Reig emphasized that the Lillo collection was the only one with mammals from the "*Arenas Puelchenses*" of the subsoil of the Buenos Aires city (as part of the Colección Rusconi). Reig also indicated the lack of space, furniture, and personnel in the collection and urged to hire a permanent technician.

Reig organized a second trip to Ischigualasto of 45 days, during May and June 1959, and was accompanied by Scaglia and Bonaparte, who were hired as technicians for this fieldwork (Abdala *et al.*, 2022; Apesteguía *et al.*, 2022a). Other members were the by then students Viera, Herbst, Cabezas, and the technician Tomás Fasola, from de IML. There were also auxiliary personnel, such as drivers, one cook, the local guide Don Victorino Herrera and his son, a botany collector named Alberto Cuezzo, a zoology collector José M. Gómez, and R. Bellmann (Bonaparte & Migale, 2015). This expedition was very successful, with a large number of fossils collected (Bonaparte, 1996, 1997; Bonaparte & Migale, 2015).

Reig worked as a researcher and professor at the Escuela de Ciencias Naturales of the IML until 1960, when he was removed from his position for political reasons by university authorities during the government of president Arturo Frondizi (1908–1995), and moved to the Universidad de Buenos Aires (Abdala *et al.*, 2022). Fossils of great relevance resulting from collections during Reig's short period at the IML were the anuran *Saltenia ibanezi*, the archosauriform *Proterochampsa barrionuevoi*, the rauisuchid *Saurosuchus galilei*, and the basal dinosaur *Herrerasaurus ischigualastensis*, all described by Reig himself (*e.g.*, Reig, 1958, 1959, 1963) and housed in the PVL. These important findings of international relevance from Ischigualasto were headline news in the country's main newspapers (see Supplementary Information, p. 11).

From his workplace in Buenos Aires city, Reig led his last expedition to Ischigualasto in 1960, supported by CONICET and with the collaboration of the IML and FML and in agreement with the Museo de La Plata and the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" of Buenos Aires. In this field trip, the logistical organizer was Bonaparte (Fig. 5), with the participation of Scaglia, the Argentine paleontologist and anthropologist Rodolfo Casamiquela (1932–2008), researchers and technicians from the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" and the Instituto de Geología y Minería of Jujuy Province. In this expedition also participated Martín Vince, a gardener from the IML and FML, who would then become

the main technician of Bonaparte for the next two decades (Fig. 5) (Bonaparte & Migale, 2005; Puerta & Isasi, 2022).

JOSÉ F. BONAPARTE IN CHARGE OF THE LVF

After the removal of Reig in 1960, the LVF was left in charge of Bonaparte, who continued the exploration and collection of fossils in Mesozoic deposits and made key discoveries that provided a new vision of the evolution of the South American Mesozoic fauna (Abdala *et al.*, 2022). Due to the abundant recent literature on the work of Bonaparte from the LVF (and PVL collection) of the IML, with multiple references to field trips, academic activities, and various aspects of his life in Tucumán (*e.g.*, Bonaparte & Migale, 2015; Abdala *et al.*, 2022; Alcober & Martínez, 2022; Apesteguía *et al.*, 2022a, 2022b; Martinelli *et al.*, 2022), we will only present a summary of its main activities and some little-known details since he arrived in 1960 until his departure in late 1978.

Bonaparte continued exploring Mesozoic localities by organizing methodical and continuous expeditions to Triassic, Jurassic, and Cretaceous continental outcrops since 1961 (Bonaparte & Migale, 2015; Abdala *et al.*, 2022). He collected notable Mesozoic tetrapods from the Triassic of San Juan, La Rioja, and Mendoza provinces and from the Cretaceous of San Luis Province (Apesteguía *et al.*, 2022a), generating a large number of materials and new information on archosauromorphs and therapsids (Abdala *et al.*, 2022a; Alcober & Martínez, 2022; Bona *et al.*, 2022; Martinelli *et al.*, 2022). The LVF under the Bonaparte's leadership reached a remarkable hierarchy because of the prompt and uninterrupted publications made it one of the most important paleontological centers in Argentina (Abdala *et al.*, 2022; Martinelli *et al.*, 2022) (see Supplementary Information, p. 11). Due to his great contributions to paleontology, the UNT awarded Bonaparte the title of *Doctor Honoris Causa* (Aceñolaza, 2018) in 1974, which allowed him to join the FCN-IML as a full professor of vertebrate paleontology, between 1975–1979 (Abdala *et al.*, 2022; Apesteguía *et al.*, 2022a, 2022b).

In 1974, Bonaparte began a series of paleontological explorations to several localities in southern Salta Province, such as the notable Cretaceous sites of El Brete and El Ceibal, where important remains of dinosaurs (*e.g.*, *Saltasaurus loricatus* and *Noasaurus leali*) and postcranial bones of enantiornithine birds were discovered (Bonaparte *et al.*, 1977; Bonaparte & Powell, 1980; Bonaparte & Migale, 2015; Abdala *et al.*, 2022; Apesteguía *et al.*, 2022a; Bona *et al.*, 2022). In addition, technicians Vince and Juan Carlos Leal and the geology student Jaime Powell—who would become the first disciple of Bonaparte—participated in these field trips (Bona *et al.*, 2022). It is also worth noting the findings made in 1975 in the Pampa Grande area, southern Salta Province, where Eocene outcrops of the Lumbrera Formation yielded many articulated cranial and postcranial remains of new mammals (*e.g.*, Carbajal *et al.*, 1977; Bond, 1981; Bond & Vucetich, 1983).

Bonaparte organized several field trips to Patagonia, from 1976 to 1978, to explore Jurassic and Cretaceous localities of Neuquén, Chubut, and Santa Cruz provinces. These resulted in several noteworthy discoveries, such as the associated remains of the sauropods *Patagosaurus fariasi* and *Elaltitan lilloi* (Powell, 1986, 2003; Mannion & Otero, 2012) and a large number of other theropod and sauropod dinosaurs. It was also of paramount importance the finding of the first nest of prosauropod dinosaurs from the Late Triassic that included eggs, newborn individuals, and a complete juvenile specimen, all referred by Bonaparte to the species *Mussaurus patagonicus* (Bonaparte & Vince, 1979).

A forgotten aspect in the most recent publications that deserves comment is the collaboration provided by Bonaparte and the LVF to create a Vertebrate Paleontology Section at the Universidad Provincial Domingo Faustino Sarmiento, San Juan Province, in 1965. It included training technicians and an associated field trip between staff of this university and the IML to search for fossils. This university, founded in August 1964, offered Bonaparte a contract as a full-time researcher in October 1965 (see Supplementary Information, p. 12). Finally, in December 1965, the Universidad Provincial de San Juan accepted Bonaparte's offer of technical collaboration for the newly created *Departamento de Paleontología* and formally appointed him as a consultant. Among other points, Bonaparte suggested the creation of a private library for the department, the development of three disciplines for the new institute (paleobotany, paleoinvertebrates, and paleovertebrates), with

permanent positions for each area and also for an historical and/or sedimentary geologist. He envisaged the main purpose of the *Departamento de Paleontología* to be the development of paleontological research for this region and the creation of a paleontological museum open to the public.

Similarly, Bonaparte and the LVF collaborated in developing a paleontology institute at the Universidad Provincial de La Rioja. This cooperation started in 1974 by donating

Figure 5. 1–2, José Fernando Bonaparte working in his office at the **FML**, *ca.* 1976 (photograms from the documentary *Nuevo Yacimiento Paleontológico* by Jorge Wyngaard, Instituto de Cinematografía of the **UNT**); **3,** José F. Bonaparte and the technician Martín Vince in the field in 1970 (from the Historical Archive of the Colección Paleontología de Vertebrados Lillo); **4,** Technicians Juan Carlos Leal and Martín Vince in a campsite in 1969 (from the Historical Archive of the Colección Paleontología de Vertebrados Lillo); **5–6,** Martín Vince preparing fossils, *ca.* 1976 (photograms from the documentary *Nuevo Yacimiento Paleontológico* by Jorge Wyngaard, Instituto de Cinematografía of the **UNT**).

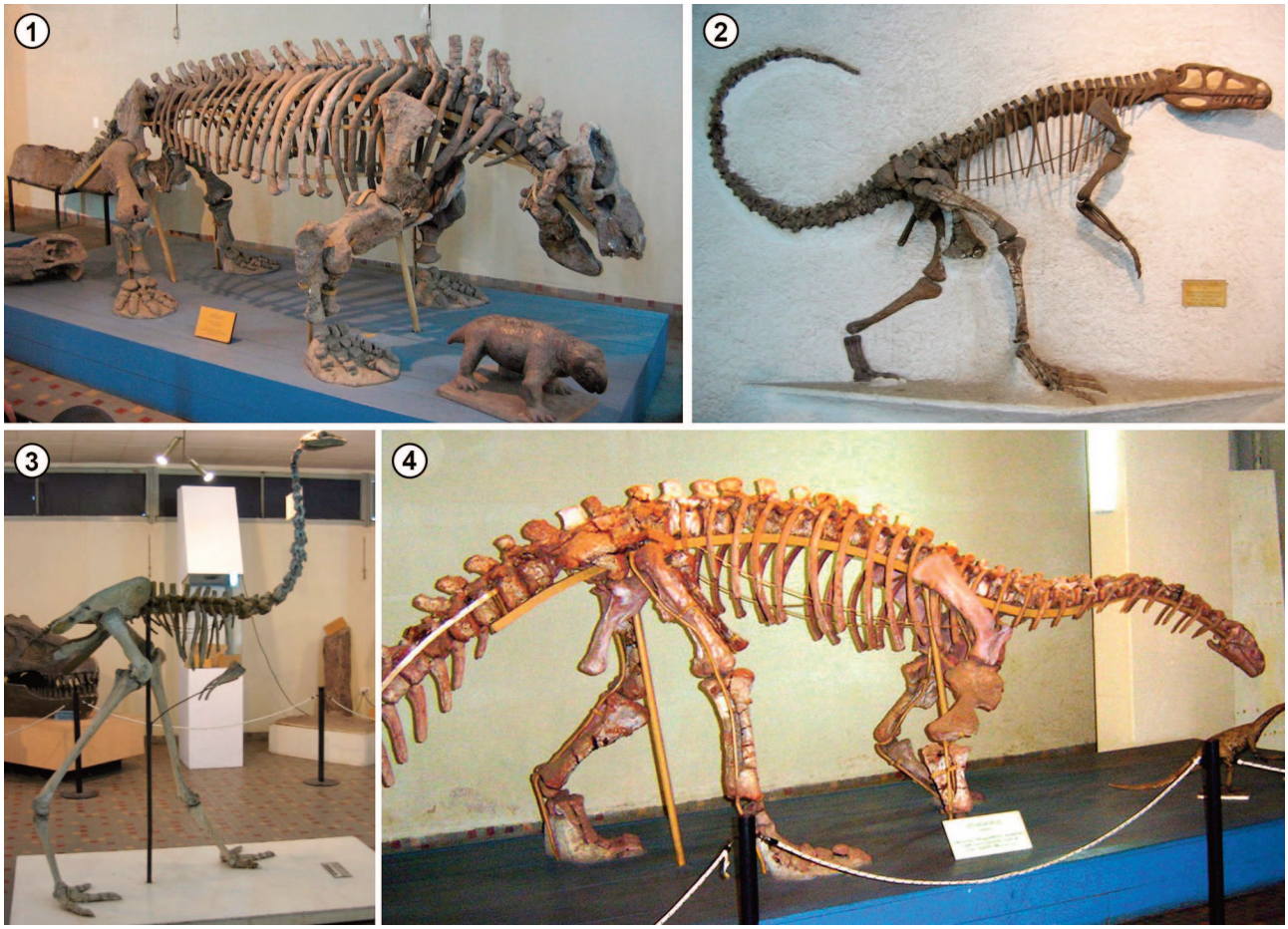

Figure 6. Some mounted original skeletons of specimens belonging to the **PVL** in the old exhibition of the Museo de Ciencias Naturales of the **FML** (from the Historical Archive of the Colección Paleontología de Vertebrados Lillo). **1,** ***Ischigualastia jenseni***; **2,** ***Herrerasaurus ischigualastensis***; **3,** ***Dinornis maximus***; **4,** ***Riojasaurus incertus***.

fossil casts, original fossil material, and loaning tools to prepare specimens. The collaboration also included advice in the field and the technical and scientific guidance for the cataloguing and conservation of specimens in the collection (see Supplementary Information, p. 13–15). Bonaparte considered it appropriate to make a formal cooperation agreement between the Universidad Provincial de La Rioja and the IML (see Supplementary Information, p. 13–16). The IML also made available its facilities in the LVF to train personnel and advice on the paleontological research possibilities offered by the fossils of that province. In addition, the possibility of making joint field trips between the interested parties was agreed (see Supplementary Information, p. 17–18). This cooperation agreement, however, would only be formally signed in 1984 (see Supplementary Information, p. 19–20).

Outreach activities carried out during Bonaparte's direction of the LVF were important, using exhibited sculptures, assembled fossils and explanatory diagrams in the museum and distributing modern brochures to the public (Figs. 6–10) (Abdala *et al.*, 2022). In this regard, it is necessary to mention here the work of the Uruguayan sculptor Roberto Fernández Larrinaga (1918–1988), who in the 1960s was hired by the IML to build sculptures of fossil animals of the Triassic of Argentina and to assemble skeletons of fossil specimens for the natural science museum managed by the FML (Figs. 6, 7, 10) (Abdala *et al.*, 2022). It is also worth noting that the Russian artist Alejandro Gavriloff (1914–1993) served as a scientific illustrator in the FML and collaborated in the exhibition (Martinelli *et al.*, 2021; Abdala *et al.*, 2022). Another of Bonaparte's outreach activities was to participate in documentaries developed by the Instituto de

Figure 7. 1–3, Setting of the original material of the dinosaur ***Elaltitan lilloi*** in the old exhibition of the Museo de Ciencias Naturales of the **FML**, late 1970s (from the personal archive of Agustín Guillermo Martinelli).

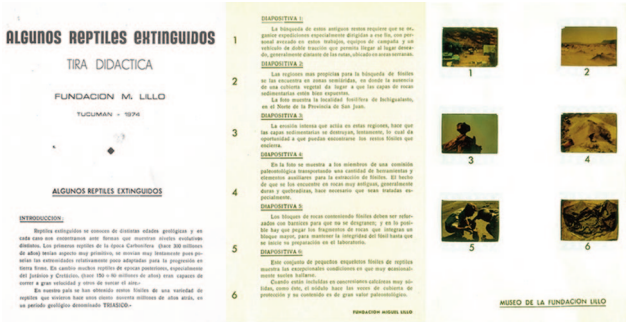

Figure 8. Brochures with slides on extinct Mesozoic reptiles and information on the search and extraction of fossils edited by the **FML** in 1974 (from the Historical Archive of the Colección Paleontología de Vertebrados Lillo).

Cinematografía of the UNT. Three documentaries portray the paleontological research developed at that time at the LVF. Two of them, *Dinosaurios* (1965) and *Reptiles fósiles triásicos de Argentina* (1965) were directed by the prominent Argentine documentalist Jorge Preloran (1933–2009) (Departamento de Documentación y Archivo Cine UNT, 2024a, 2024b); the third documentary, *Nuevo Yacimiento Paleontológico* (1975), documented the extraction and preparation of fossils from the Cretaceous of Salta Province, northwest Argentina, by the Argentine producer Jorge Wyngaard (1929–2008) (Departamento de Documentación y Archivo Cine UNT, 2024c).

JAIME POWELL, CURATOR OF THE PVL COLLECTION

When Bonaparte left the IML at the end of 1978, the LVF dissolved and the fossil collection became known as PVL.

Figure 9. New Museo Miguel Lillo de Ciencias Naturales, which now exhibits fossil replicas. **1,** Front of the museum; **2,** ***Herrerasaurus ischigualastensis***; **3,** ***Riojasaurus incertus***; **4,** Partial view of the museum with the temnospondyl amphibian ***Pelorocephalus mendozensis*** in the foreground; **5,** sector dedicated to Quaternary fossils with the gomphothere ***Cuvieronius hyodon***, the ground sloth ***Megatherium americanum***, and the glyptodont ***Glyptodon reticulatus***; **6,** skull of the saber-toothed tiger ***Smilodon***; **7,** skull of the dicynodont therapsid ***Ischigualastia jenseni***.

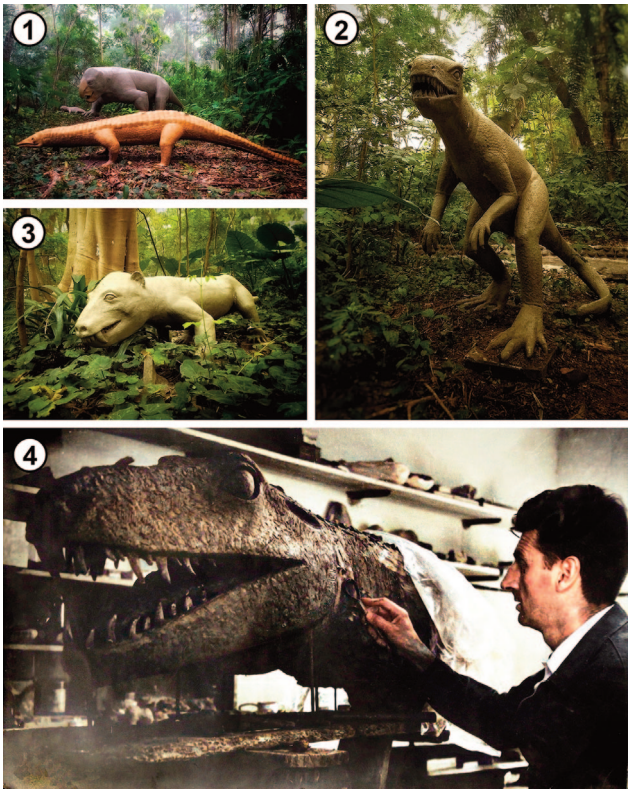

Figure 10. Sculptures of Triassic fossils of Ischigualasto made by Roberto Fernández Larrinaga located in the gardens of the **FML**. **1,** ***Aetosauroides scagliai*** in foreground, ***Ischigualastia jenseni*** in the center, and ***Hyperodapedon sanjuanensis*** in the background; **2,** ***Herrerasaurus ischigualastensis***; **3,** ***Exaeretodon argentinus***; **4,** Roberto Fernández Larrinaga sculpting ***Saurosuchus galilei***, which unfortunately it was never mounted.

The Argentine geologist Jaime Eduardo Powell (1953–2016, Fig. 11), who had recently graduated at the FCN-IML, was left in charge of the PVL, serving as curator of the collection from 1979 to 2016. Powell also acted as a professor of vertebrate paleontology at the FCN-IML and as a CONICET researcher. He began his research on South American titanosaur dinosaurs under the direction of Bonaparte (Bonaparte *et al.*, 1977; Powell, 1978, 1979, 1980, 2003; Bonaparte & Powell, 1980), defending his Ph.D. thesis in 1986. Powell, along with Bonaparte, drew particular attention to the remarkably complete titanosaur *Saltasaurus loricatus*, the first sauropod known to possess an armour of bony plates embedded in its skin (Powell, 1979, 1980, 1986, 2003). As part of his Ph.D. thesis, Powell carried out exploratory fieldwork to northern Patagonia and Cretaceous localities in Salta and Tucumán provinces. His only field trip to northern Patagonia allowed incorporating important remains of dinosaur eggs and nests into the PVL collection, some of which were studied afterward (*e.g.*, Powell, 1992, Moratalla & Powell, 1994; Figueroa & Powell, 1999). More details of these discoveries and their respective publications have been recently summarized by Abdala *et al.* (2022). It is also necessary to mention the work of another important artist linked to the vertebrate paleontology research in the IML and the FML since the early 1980s, the plastic artist Enrique Guanuco. He made scientific illustrations of fossils that were included in the scientific production of various IML and FML researchers for decades (Abdala *et al.*, 2022) (Fig. 12).

In the earliest 1980s, Powell began to explore Paleogene localities in northwestern Argentina, which resulted in the discovery of important fossiliferous deposits such as the El Tonco valley and Alemanía, in the south of

Figure 11. Jaime Eduardo Powell (1953–2016) (photographs from the Historical Archive of the Colección Paleontología de Vertebrados Lillo). **1,** Jaime E. Powell and José F. Bonaparte in the preparation laboratory showing the recently discovered dinosaur eggs in northern Patagonia; at the background, the renowned paleontologists Guiomar Vucetich and Zulma Brandoni de Gasparini, in 1986; **2,** Jaime E. Powell in a field trip to Eocene deposits from El Simbolar, Salta Province, in 2014; **3,** Jaime E. Powell with a technician at the El Brete locality, Salta Province, preparing the motorcycle used to transport fossil pieces to the camp, *ca.* 1975; **4,** Jaime E. Powell at the **PVL** in 2007.

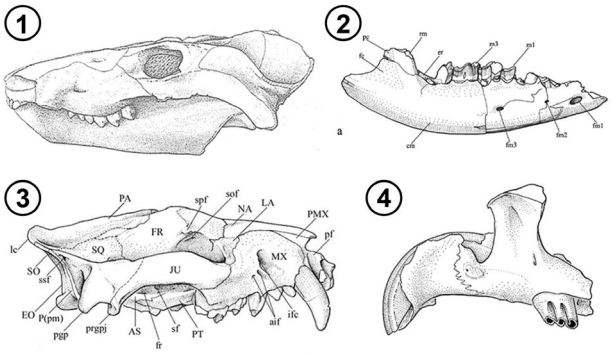

Figure 12. Some of the scientific illustrations made by the artist Enrique Guanuco. **1,** Skull of the holotype of the cynodont ***Cynognathus minor*** (**PVL 3859**) (reproduced from Abdala, 1996); **2,** Right mandible of the metatherian Borhyaenoidea aff. ***Stylocynus*** (**PVL 4651**) (from Babot & Ortiz, 2008); **3,** Skull of the holotype of the carnivorous metatherian ***Callistoe vincei*** (**PVL 4187**) (from Babot *et al.*, 2002); **4,** Anterior fragment of the skull of a paratype of the sigmodontine rodent ***Tafimys powelli*** (**PVL 5450**) (from Ortiz *et al.*, 2000).

Salta Province, and the Paleocene locality of Río Loro, nearby the city of Tucumán (Powell & Palma, 1981; Soria & Powell, 1981; Goin *et al.*, 1986; Gasparini *et al.*, 1993; Powell *et al.*, 2011; Babot *et al.*, 2017). Powell made remarkable discoveries of peculiar crocodiles and mammals where the Paleocene Río Loro Formation outcrops (Powell & Palma, 1981; Soria & Powell, 1981; Gasparini *et al.*, 1993). Among the most important mammals discovered and described in those years are the basal ungulates *Eoastrapostylos riolorense* (Soria & Powell, 1981), *Notonychops powelli* (Soria, 1989a), and *Satshatemnus bonapartei* (Soria, 1989b). Powell and his students continued to explore these outcrops in successive years, leading to the discovery of novel mammalian and crocodilian taxa such as the very peculiar crocodile *Lorosuchus nodosus* (Pol & Powell, 2011; see below). Moreover, Powell continued excavating the rich Eocene Pampa Grande deposits in Salta Province, where he found the litoptern *Indalecia grandensis* (Bond & Vucetich, 1983), the notoungulates *Boreastylops lumbrerensis* (Vucetich, 1980), *Colbertia lumbrerense* (Bond, 1981), and *Pampahippus arenalesi* (Bond & López, 1993), and the spectacularly almost complete articulated skeleton of the carnivorous proborhyaenid metatherian *Callistoe vincei* (Babot *et al.*, 2002). Other important discovery made by Powell in his field trips south of Salta Province was the sebecid crocodile *Bretesuchus bonapartei* from the Paleogene Maíz Gordo Formation in the area of El Brete (Gasparini *et al.*, 1993).

In the following decades, Powell expanded his line of research to the Neogene and Quaternary, making important discoveries in Late Miocene Saladillo Formation outcrops, such as the small megatheriid *Anisodontherium* sp. (Brandoni *et al.* 2012), and in the Quaternary of Tafí valley, northwestern Tucumán Province. In this valley were discovered the glyptodonts *Glyptodon clavipes* and *G. reticulatus*, the megatheriid *Megatherium americanum*, the mylodontid *Paraglossotherium elmollarum*, the gomphotheriid *Cuvieronius* cf. *C. hyodon*, the equid *Hippidion* sp., and the camelid *Vicugna vicugna*, many of them later studied by Powell's students (Esteban, 1988, 1993; Rufino & Mulé, 1994; Torres-Carro *et al.*, 2021; see also Powell & Ortiz, 2014; Ortiz *et al.*, 2019a). Throughout his entire time as a curator, Powell always petitioned the FCN-IML authorities to improve the conditions and space for the collection, the fossil preparation lab, and the museum but his efforts were always unsuccessful (see Supplementary Information, p. 21).

In the mid-1980s, Powell began attracting students of the FCN-IML. Among them, it is worth mentioning Andrea Arcucci, who began her studies on Argentine Triassic archosaur reptiles mostly from the PVL collection (*e.g.*, Arcucci, 1989a, 1989b, 1990; Sereno & Arcucci, 1990). Arcucci completed her Master's degree at the FCN-IML on Triassic dinosauriforms and her Ph.D. thesis at the Universidad Nacional de San Luis on proterochampsid archosauriforms. Also, FCN-IML students Norma Nasif and Graciela Esteban began working on fossils from the PVL collection. Nasif finished her undergraduate research work with Neogene flamingos from northwestern Argentina (Nasif, 1988) and Esteban finished her undergraduate degree studying Quaternary megatheriid and mylodontid xenarthrans (Esteban, 1988, 1993). Later, Esteban developed her Ph.D. thesis on mylodontids, whereas Nasif did it on Neogene dinomyid rodents. From the early 1990s, Nasif and Esteban continued exploring and studying Neogene mammals from northwestern Argentina, organizing multiple field trips to Miocene–Pliocene outcrops in the Calchaquí valleys of Tucumán, Catamarca, and Salta provinces (Nasif, 1998; Nasif *et al.*, 2000, 2007) and nearby areas of La Rioja Province (Georgieff *et al.*, 2004) (Fig. 13). These trips yielded a vast record of fossils, including new species of dasypodids such as *Neophractus martae*, *Vetelia gandhii*, and *Chasicotatus*

peiranoi (Esteban & Nasif, 1996) and the toxodontid *Calchaquitherium mixtum* (Nasif *et al.*, 2000, 2019). Esteban's work focused on the study of the fossil xenarthrans (Esteban *et al.*, 2014 and references therein), describing important fossils from the Andean intermountain valleys, some of them new taxa such as *Paraglossotherium elmollarum* and *Glossotherium emmersonni* (Esteban, 1988, 1993; Esteban & Nasif, 1996). During this period, both Nasif and Esteban were also professors at the FCN-IML, working in collaboration with Herbst, by this time an eminent paleobotanist, the geologist Sergio Georgieff, and the paleontologist Fernando Abdala (Fig. 13).

Fernando Abdala was also Powell's student, finishing his Ph.D. thesis in 1996 at the FCN-IML on Triassic cynodonts of South America, a topic in which he continues working today (Fig. 14). Since 1998, he moved abroad (Brazil and South Africa) and returned to the IML paleontological community in 2016. He redescribed the only known South American cynognathid specimen, originally referred as *Cynognathus minor* (Abdala, 1996), and published mainly on cynodonts and other therapsids from South America, Africa, and China (*e.g.*, Abdala & Giannini, 2002; Abdala & Ribeiro, 2003; Abdala & Teixeira, 2004; Abdala *et al.*, 2008, 2013; Liu & Abdala, 2022).

Many FCN-IML students who worked for a short period in the 1990s with specimens from the PVL collection also contributed to the knowledge of the regional paleofauna with some scientific publications (*e.g.*, Rufino & Mulé, 1994; Duarte, 1997; Nasif *et al.*, 2000). Pablo Ortiz and Judith Babot (Figs. 15, 16), also former students of Powell, continue working on paleomammalogy in the FCN-IML and the FML to this day. The research of Ortiz, focused on the study of Neogene and Quaternary cricetid rodents and small mammal assemblages, allowed recognizing extinct taxa such as the cricetids *Tafimys powelli* (Ortiz *et al.*, 2000, 2011, 2019a, 2019b; Ortiz & Pardiñas, 2001) and *Pardinamys humahuaquensis* (Ortiz *et al.*, 2012a, 2012b) (Figs. 15, 16), as well as other small vertebrates like the lizard *Uquiasaurus heptanodonta* (Daza *et al.*, 2012) and the anura *Rhinella xerophylla* (Ponssa *et al.*, 2022). In addition, Ortiz's studies have contributed to the understanding of paleoenvironmental fluctuations in the late Quaternary, a novel research program for the region (Figs. 15, 16). Babot conducted her Ph.D. studies in cranial and postcranial anatomy and phylogeny of sparassodonts from the Paleogene of Argentina, among which is the notable proborhyaenid *Callistoe vincei*, documented by a nicely preserved and complete articulated skeleton (Babot *et al.*, 2002, 2022; Argot & Babot, 2011; Babot & Forasiepi, 2016)

Figure 13. Graciela Esteban and Norma Nasif on field trips at late Neogene sites of Catamarca Province in the 1990s. **1,** Norma Nasif (left) and Graciela Esteban; **2,** The biologist Sebastián Musalén (left), Norma Nasif, and the paleobotanist Rafael Herbst (right); **3,** Sebastián Musalén (right), Graciela Esteban, and three field assistants; **4,** The geologist Sergio Georgieff (left), Norma Nasif, Graciela Esteban, and two field assistants.

Figure 14. Some field trips of Fernando Abdala. **1,** From left to right: field assistant, Andrea Arcucci, Fernando Abdala, Guillermo Rougier, Marcelo de la Fuente, Diego Pol, and Santiago Reuil in outcrops of Los Colorados Formation, La Rioja Province in 1992; **2,** from left to right: Graciela Esteban, the student Claudia Gómez Cardozo, Norma Nasif, and Fernando Abdala in a late Neogene outcrop, Catamarca Province in 1990s; **3,** From left to right: Guillermo Rougier, Fernando Abdala, Marcelo Isasi, and Diego Rougier at Talampaya National Park, La Rioja Province in 1992; **4,** Fernando Abdala (left) and Brazilian paleontologists Ana Maria Ribeiro and Max Cardoso Langer in Triassic outcrops of the Santa Maria Formation, Rio Grande do Sul, Brazil in 2005.

(Figs. 12, 15). She also worked on Neogene metatherians (*e.g.*, Babot & Ortiz, 2008), including argyrolagids (García-López & Babot, 2015a; Babot & García-López, 2016). More recently, her work has focused on prospecting Paleogene outcrops of the Argentinian Puna through traditional and screening sampling techniques, the latter rarely used in Paleogene outcrops in the region (Fig. 17). This resulted in a notable increase on the knowledge of Eocene small vertebrates (Babot *et al.*, 2012, 2020; García-López & Babot, 2015b; Armella *et al.*, 2016; Ciancio *et al.*, 2016).

Continued efforts of other former students of Powell in the 2000s have increased (and continue to increase) the PVL collection with new and peculiar fossils studied by themselves: Daniel García-López, Claudia Herrera, Virginia Deraco, and Carolina Madozzo-Jaén (Figs. 16–20). García-López's research led to the discovery of new notoungulates and other native ungulates from the Paleogene of northwestern Argentina (*e.g.*, García-López & Powell, 2009, 2011; García-López & Babot, 2015b; Deraco & García-López, 2015; García-López *et al.*, 2018), such as *Griphotherion*

Figure 15. Field trips of the vertebrate paleontology group led by Jaime E. Powell in the 1990s. **1,** From left to right: Rossana Duarte, Jaime E. Powell, Pablo E. Ortiz, and the technician Juan M. Ballesteros in Tafí valley, Tucumán Province in 1992; **2,** From left to right: Pablo E. Ortiz, Juan M. Ballesteros, Jaime E. Powell, Dolores Juri, and Judith Babot in late Pleistocene outcrops at La Angostura, Tucumán Province in 1997; **3,** From left to right: the technician José Aguilar, Judith Babot, and the biologist Marcos Mirande in Neogene deposits of Campo del Pucará, Catamarca Province in 1999; **4,** José Aguilar, Pablo E. Ortiz, and Judith Babot in Quaternary outcrops at La Angostura, Tafí valley, Tucumán Province in 2000.

Figure 16. Field works in Quaternary outcrops of Catamarca and Tucumán provinces. **1,** From left to right: Daniel García-López, the biologist Pablo Jayat, and Pablo E. Ortiz at Las Juntas, Catamarca Province in 2006; **2,** Dry screening of sediments near Tafí del Valle, Tucumán Province in 2006; **3,** From left to right: Virginia Deraco, Pablo E. Ortiz, Franck Barbière, and Vanessa Torres Carro screen washing sediments at La Mesada, Tucumán Province in 2015; **4,** Daniel García-López and Carolina Madozzo-Jaén screen washing sediments at Salí river, Tucumán Province in 2006; **5,** Campo del Pucará, Catamarca Province in 2013; **6,** From left to right: the field assistant Günther Ortiz Tempel, Carolina Madozzo-Jaén, the biologist Sofía d'Hiriart, Daniel García-López, and Pablo E. Ortiz at Las Chacritas, Catamarca Province, in 2013.

peiranoi, *Dolichostylodon saltensis*, and *Pampahippus powelli*, and to the expand the knowledge of other groups (García-López, 2011; Armella *et al.*, 2016; García-López *et al.*, 2018, 2019, 2020) (Figs. 16–20). Herrera's main research is on the anatomy and phylogeny of Paleogene Dasypodidae (Xenarthra) from northwest Argentina, discovering new armadillos with peculiar features in the skull, dentition, and mobile osteoderms, such as *Pucatherium parvum* and *Lumbreratherium oblitum* (Powell *et al.*, 2011; Herrera *et al.*, 2012, 2016, 2019, 2021; Ciancio *et al.*, 2016; Herrera & Esteban, 2017) (Figs. 17, 18, 20). The research of Deraco on systematic, phylogeny, and biogeography of Paleogene notoungulates, mainly toxodonts, from northwest Argentina (Deraco *et al.*, 2008) has led to the discover of new important taxa such as *Coquenia bondi* and *Pampahippus secundus* (Deraco *et al.*, 2008; Deraco & García-López, 2015; García-López *et al.*, 2018, 2019) (Figs. 17, 18, 20). Madozzo-Jaén's research on Neogene caviid rodents resulted in the recognition of new species for the region, such as *Paleocavia mawka*, and solving several taxonomic problems of the group (Madozzo-Jaén & Pérez, 2016; Madozzo-Jaén *et al.*, 2018, 2021; Madozzo-Jaén, 2019) (Figs. 16, 18–20).

The paleontologists linked to the PVL collection organized the first symposium for the study of the Miocene–Pleistocene in central and northern Argentina in September 2012 (Fig. 18). This meeting created an interdisciplinary space to integrate paleontological, biostratigraphic, and chronological information of the Miocene–Pleistocene interval to solve regional problems and since then is held every two years.

Other researchers of the FCN-IML and FML paleontological community are Sara Bertelli, working on living and extinct tinamous birds and enantiornhites (Bertelli *et al.*, 2006, 2011, 2014) (Fig. 20); Nadia Haidr, mainly focused on fossil penguins (Haidr & Acosta Hospitaleche, 2012, 2017) (Figs. 17, 20); Matías Armella, studying Neogene native ungulates (Armella *et al.*, 2016, 2018, 2020; Armella, 2022) (Figs. 17–20); the Belgian Christophe Hendrickx, who

Figure 17. Field works in Paleogene outcrops. **1,** Daniel García-López and Luis Saade at El Simbolar, Salta Province in 2022; **2,** From left to right: Judith Babot, Matías A. Armella, Claudia Herrera, and Daniel García-López at Antofagasta de la Sierra, Catamarca Province in 2014; **3,** From left to right: Norberto Giannini, Guillermo Rougier, Virginia Deraco, Sara Bertelli, Judith Babot, and Claudia Herrera at El Simbolar, Salta Province in 2019; **4,** From bottom to top: Judith Babot, Rodrigo González, and Daniel García-López at Antofagasta de la Sierra, Catamarca Province in 2016; **5,** From left to right: Gonzalo Bravo, Luis Saade, Vanessa Torres Carro, Daniel García-López, Judith Babot, Nadia Haidr, the student Diego Cantone, and Jaime Morales at Pampa Grande, Salta Province in 2022.

Figure 18. 1, Attendees of the *Primer Simposio del Mioceno–Pleistoceno del Centro y Norte de Argentina* in San Miguel de Tucumán, September 2012; **2,** From left to right: Carolina Madozzo-Jaén, Pablo E. Ortiz, and Norma Nasif in late Neogene outcrops of El Cajón valley, Catamarca Province in 2012; **3,** From left to right: Pablo E. Ortiz, Judith Babot, Norma Nasif, Carolina Madozzo-Jaén, and Graciela Esteban in late Neogene outcrops of El Cajón valley, Catamarca Province in 2012; **4,** From left to right: Daniel García-López, Judith Babot, Matías A. Armella, Vanessa Torres Carro, and Pablo E. Ortiz in late Neogene outcrops of Palo Pintado Formation near Santa Rosa, Salta Province in 2013.

studies the dentition of Triassic cynodonts and the paleobiology of dinosaurs (Hendrickx *et al.*, 2020a, 2020b) (Fig. 20); and the French Franck Barbière, studying cricetid rodents (Barbière *et al.*, 2016a, 2016b, 2019a, 2019b) (Figs. 16, 19). Other Ph.D. students, Jaime Morales, Luis Saade, Gonzalo Bravo, and Vanessa Torres Carro, have been incorporated to the vertebrate paleontology area in the FCN-IML or the FML in the last decade, studying Cretaceous enantiornitheans birds, Paleogene ungulates and crocodiles, Neogene octodontid rodents, and Pleistocene camelids (*e.g.*, Bravo *et al.*, 2021; Torres Carro *et al.*, 2021; Saade *et al.*, 2023) (Figs. 16–20). The technical staff currently working at the PVL are the fossil preparator José Aguilar, who has been in the preparation lab since the 1990s, and Rodrigo González and Flavia Germano, both collection managers since 2013 and 2023, respectively. Both Aguilar and González were part of the team that frequently accompanied Powell on his field trips and helped develop the projects of researchers and students working with material of the collection (Figs. 15, 17, 20).

PRESENT AND FUTURE

As a result of more than 60 years of continuous work of collecting and research on fossil vertebrates in the PVL collection, around 7,900 specimens have been cataloged to date (Fig. 21). After Bonaparte's departure at the end of 1978 and until 2016, the director of the PVL collection was Powell, and since then it has been Ortiz. On August 2010, after the procedures started by Powell, the PVL collection was registered with the national authority on paleontological matters (Pablo Tubaro, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"), Law 25.743 for the protection of archaeological and paleontological heritage, under the name FCN-IML.

Figure 19. Field works in late Neogene outcrops. **1,** Levels of the India Muerta Formation near Vipos, Tucumán Province in 2012; **2,** Outcrops of the Andalhuala Formation at Encalilla, Tucumán Province in 2015; **3,** Daniel García-López, Matías A. Armella, Vanessa Torres Carro, and Carolina Madozzo-Jaén in Encalilla, Tucumán Province in 2017; **4,** From left to right: Franck Barbière, Claudia Herrera, Graciela Esteban, Carolina Madozzo-Jaén, Pablo E. Ortiz, and Norma Nasif in Chiquimil Formation outcrops near San José, Catamarca Province in 2015; **5,** Pablo E. Ortiz and Graciela Esteban prospecting outcrops of the Andalhuala Formation at Entre Ríos, Santa María valley, Catamarca Province in 2015; **6,** Carolina Madozzo-Jaén and Vanessa Torres Carro prospecting outcrops of the Andalhuala Formation at Puerta de Corral Quemado, Catamarca Province in 2021.

The development of the LVF in its early days, especially under the direction of Bonaparte, strongly stimulated the field of vertebrate paleontology, becoming a national and international point of reference for research in the continental Mesozoic. Currently, the collection is regularly visited by researchers worldwide, mainly for its remarkable unique collection of archosaurs and therapsids from the South American Triassic. The lack of Mesozoic terrestrial continental outcrops in Tucumán Province and the fact that the majority of Argentine provinces with continental Mesozoic records currently have research institutions and important groups of local paleontologists, resulted in the end of the incorporation of vertebrate material of this age to PVL (Abdala *et al.*, 2022). Therefore, in the last three decades PVL has grown due to the contribution of researchers who do fieldwork locally and thus, more closely linked to the study of Cenozoic mammals. Currently, the PVL collection and the *Cátedra de Paleontología* of the FCN-IML encompass a large group of paleontologists linked to different institutions (CONICET, Instituto Superior de Correlación Geológica, FML, Unidad Ejecutora Lillo and FCN-IML), most of them researching on mammal paleontology (Fig. 20).

The "Lillo", as the FCN-IML and the FML as a whole are known, is the oldest natural history institution in northwest Argentina, with great visibility among the scientific institutions of Tucumán. Since creatures from the remote past awake the imagination and fascination of visitors, the fossils from the PVL collection exhibited at the Museo Lillo de Ciencias Naturales are its main attraction (Fig. 9). The PVL collection also stands out within the "Lillo" for preserving a large number of holotype specimens and materials of high scientific value that are key reference for researchers around the world. Publications of a high academic level developed by Lillo researchers linked to the PVL collection and the several ongoing projects maintain the relevance of the collection and allow creating new lines of research. The increase in the number of students and scholars in recent years is promising for the future of vertebrate paleontology in northwest Argentina.

Figure 20. Staff that currently carries out vertebrate paleontology fieldwork in institutions related to "El Lillo" (**FML**, **FCN-IML**, Unidad Ejecutora Lillo [**FML-CONICET**]), Instituto Superior de Correlación Geológica (**UNT-CONICET**). **1,** Rodrigo González; **2,** Pablo E. Ortiz; **3,** Carolina Madozzo-Jaén; **4,** José Aguilar; **5,** Norma Nasif; **6,** Claudia Herrera; **7,** Graciela Esteban; **8,** Judith Babot; **9,** Fernando Abdala; **10,** Daniel García-López; **11,** Virginia Deraco; **12,** Matías A. Armella; **13,** Vanessa Torres Carro; **14,** Gonzalo Bravo; **15,** Luis Saade; **16,** Christophe Hendrickx; **17,** Jaime Morales; **18,** Sara Bertelli; **19,** Nadia Haidr.

TABLE 1 – List of type specimens housed in the Colección Paleontología de Vertebrados Lillo

Taxon	Holotype	Author, year	Comments
Ctenomys dasseni	PVL 739	Rusconi, 1931	Rusconi coll. 161
Dicoelophorus chapadmalensis	PVL 1270	Rusconi, 1932	Rusconi coll. (no number)
Ceratophrys ensenadensis	PVL 767	Rusconi, 1932	Rusconi coll. 413
Rhea americana anchorenense	PVL 1286	C. Ameghino & Rusconi, 1932	Rusconi coll. 639
Tremacebus harringtoni	PVL 619	Rusconi, 1933	Rusconi coll. 661
Plataeomys castellanosi	PVL 1252	Rusconi, 1933	Rusconi coll. 425
Nothydrochoerus fontanai	PVL 645	Rusconi, 1933	Rusconi coll. 509
Macrocavia simpsoni	PVL 1026	Rusconi, 1933	Rusconi coll. 501
Microcavia parca	PVL 1009	Rusconi, 1948	Rusconi coll. 1421
Palaeolama weddelli parodii	PVL 1203	Rusconi, 1933	Rusconi coll. 418
Pseudalopex proplatensis inexpectatus	PVL 1287	Rusconi, 1933	Rusconi coll. 438
Notopachyrukhos tambuttoi	PVL 550	Rusconi, 1933	Rusconi coll. 514
Tetrastylus angustidens	PVL 1040	Rusconi, 1934	Rusconi coll. 704
Diaphoromys fiegi	PVL 540	Rusconi, 1934	Rusconi coll. 741
Glossotherium incertum sanluisence	PVL 1525	Rusconi, 1935	Rusconi coll. 1050
Xenohydrochoerus ballesterensis	PVL 705	Rusconi, 1934	Rusconi coll. 556
Tapirus (Tapiralum) greslebini	PVL 718	Rusconi, 1934	Rusconi coll. 562
Eumysops incertus	PVL 1020	Rusconi, 1935	Rusconi coll. 854
Stereotoxodon tehuelche guinazui	PVL 1527	Rusconi, 1936	Rusconi coll. 1176
Acrotypotherium tapiai	PVL 1526	Rusconi, 1936	Rusconi coll. 1175
Canis (Dusicyon) avus	PVL 532	Rusconi, 1936	Rusconi coll. 107
Notocaiman stromeri	PVL 752	Rusconi, 1937	Rusconi coll. 1205
Leiosaurus marelli	PVL 906	Rusconi, 1937	Rusconi coll. 1215
Glossotherium robustum flexum	PVL 895	Rusconi, 1944	Rusconi coll. 1195
Pseudolestodon puelchensis	PVL 696	Rusconi, 1944	Rusconi coll. 830
Plesiomegatherium triangulatum	PVL 828	Rusconi, 1944	Rusconi coll. 738
Myocastor brevirostris	PVL 1059	Rusconi, 1944	Rusconi coll. 1212
Cardiomys (Pseudocardiomys) puelchensis	PVL 1043	Rusconi, 1944	Rusconi coll. 1228
Plexochoerus puelchensis	PVL 1010	Rusconi, 1944	Rusconi coll. 1301
Toxodontherium triangulatum	PVL 548	Rusconi, 1944	Rusconi coll. 1325
Tramyocastor majus	PVL 1037	Rusconi, 1945	Rusconi coll. 1392
Diaphoromys arctus	PVL 1042	Rusconi, 1945	Rusconi coll. 1395
Gyriabrus latidens	PVL 1034	Rusconi, 1945	Rusconi coll. 1136
Gyriabrus quadratus	PVL 1041	Rusconi, 1945	Rusconi coll. 1302
Myocastor brevirostris ballesterensis	PVL 1195	Rusconi, 1945	Rusconi coll. 1403
Isostylomys laevis	PVL 1035	Rusconi, 1945	Rusconi coll. 1162
Scelidotherium parodii puelchense	PVL 902	Rusconi, 1948	Rusconi coll. 1373
Xenohydrochoerus gracilis	PVL 704	Rusconi, 1949	Rusconi coll. 1409
Trigodon gaudryi quadratus	PVL 539	Rusconi, 1949	Rusconi coll. 1018
Onohippidium compressidens magnum	PVL 716	Rusconi, 1949	Rusconi coll. 1211
Saltenia ibanezi	PVL 2010	Reig, 1959	
Saurosuchus galilei	PVL 2062	Reig, 1959	

TABLE 1 – Continuation

Taxon	Holotype	Author, year	Comments
Proterochampsa barrionuevoi	PVL 2063	Reig, 1959	
Aetosauroides scagliai	PVL 2073	Casamiquela, 1960	
Argentinosuchus bonapartei	PVL 2091	Casamiquela, 1960	
Shelania pascuali	PVL 2186	Casamiquela, 1960	
Vieraella herbsti	PVL 2488	Reig, 1961	
Herrerasaurus ischigualastensis	PVL 2566	Reig, 1963	
Promastodonsaurus bellmani	PVL 2092	Bonaparte, 1963	
Trialestes romeri	PVL 2561	Reig, 1963	
Proexaeretodon vincei	PVL 2565	Bonaparte, 1963	
Ischignathus sudamericanus	PVL 2564	Bonaparte, 1963	
Kannemeyeria argentinensis	PVL 3465	Bonaparte, 1966	
Pisanosaurus mertii	PVL 2577	Casamiquela, 1967	
Bufo pisanoi	PVL 2197	Casamiquela, 1967	
Riojasuchus tenuisceps	PVL 3827	Bonaparte, 1969	
Pseudhesperosuchus jachaleri	PVL 3830	Bonaparte, 1969	
Hemiprotosuchus leali	PVL 3829	Bonaparte, 1969	
Riojasaurus incertus	PVL 3808	Bonaparte, 1969	
Strenusaurus procerus	PVL 3663	Bonaparte, 1969	
Andescynodon mendozensis	PVL 3833	Bonaparte, 1969	
Neoaetosauroides engaeus	PVL 3525	Bonaparte, 1969	
Vinceria andina	PVL 3831	Bonaparte, 1969	
Cynognathus minor	PVL 3859	Bonaparte, 1969	
Rusconiodon mignonei	PVL 3840	Bonaparte, 1970	
Jachaleria colorata	PVL 3841	Bonaparte, 1970	
Pterodaustro guinazui	PVL 2571	Bonaparte, 1970	
Venaticosuchus rusconii	PVL 2578	Bonaparte, 1971	
Cromptodon mamiferoides	PVL 3858	Bonaparte, 1972	
Lagosuchus lilloensis	PVL 3871	Romer, 1972	
Puntanipterus globosus	PVL 3869	Bonaparte & Sánchez, 1975	
Callopistes bicuspidatus	PVL 4618	Chani, 1976	
Bolomys bonapartei	PVL 2396	Reig, 1978	
Phyllotis (Auliscomys) formosus	PVL 2397	Reig, 1978	
Mussaurus patagonicus	PVL 4068	Bonaparte & Vince, 1979	
Patagosaurus fariasi	PVL 4170	Bonaparte, 1979	
Piatnitzkysaurus floresi	PVL 4073	Bonaparte, 1979	
Volkheimeria chubutensis	PVL 4077	Bonaparte, 1979	
Bonapartherium hinakusijum	PVL 4018	Pascual, 1980	
Chaliminia musteloides	PVL 3857	Bonaparte, 1980	
Saltasaurus loricatus	PVL 4017-92	Bonaparte & Powell, 1980	
Noasaurus leali	PVL 4061	Bonaparte & Powell, 1980	
Fasolasuchus tenax	PVL 3850	Bonaparte, 1981	
Enantiornis leali	PVL 4035	Walker, 1981	
Eoastrapostylops riolorense	PVL 4216	Soria & Powell, 1981	
Colbertia lumbrerense	PVL 4607	Bond, 1981	

TABLE 1 – Continuation

Taxon	Holotype	Author, year	Comments
Indalecia grandensis	PVL 4186	Bond & Vucetich, 1983	
Pseudolagosuchus major	PVL 4629	Arcucci, 1987	
Glossotherium emmersoni	PVL 3874	Esteban, 1988	
Notonychops powelli	PVL 4298	Soria, 1989	
Satshatemnus bonapartei	PVL 4297	Soria, 1989	
Tropidosuchus romeri	PVL 4601	Arcucci, 1990	
Yungavolucris brevipedalis	PVL 4053	Chiappe, 1993	
Lectavis bretincola	PVL 4021	Chiappe, 1993	
Soroavisaurus australis	PVL 4690	Chiappe, 1993	
Bretesuchus bonapartei	PVL 4735	Gasparini *et al.*, 1993	
Pampahippus arenalesi	PVL 4192	Bond & López, 1993	
Paraglossotherium elmollarum	PVL 4633	Esteban, 1993	
Neophractus martae	PVL 4795	Esteban & Nasif, 1996	
Chasicotatus peiranoi	PVL 4796	Esteban & Nasif, 1996	
Vetelia gandhii	PVL 4800	Esteban & Nasif, 1996	
Lessemsaurus sauropoides	PVL 4822-1	Bonaparte, 1999	
Calchaquitherium mixtum	PVL 4794	Nasif *et al.,* 2000	
Limenavis patagonica	PVL 4731	Clarke & Chiappe, 2001	
Tafimys powelli	PVL 4825	Ortiz *et al.*, 2000	
Callistoe vincei	PVL 4187	Babot *et al.*, 2002	
Martinavis vincei	PVL 4054	Walker *et al.*, 2007	
Coquenia bondi	PVL 5853	Deraco *et al.*, 2008	
Dolichostylodon saltensis	PVL 6219-A	García-López, 2009	
Martinavis saltariensis	PVL 4025	Walker & Dyke, 2009	
Martinavis whetstonei	PVL 4028	Walker & Dyke, 2009	
Martinavis minor	PVL 4046	Walker & Dyke, 2009	
Elbretornis bonapartei	PVL 4022	Walker & Dyke, 2009	
Megapaloelodus peiranoi	PVL 3327	Agnolin, 2009	
Chasicotatus powelli	PVL 3212	Scillato-Yané *et al.*, 2010	
Lorosuchus nodosus	PVL 6219-B	Pol & Powell, 2011	
Griphotherion peiranoi	PVL 5903	García-López & Powell, 2011	
Uquiasaurus heptanodonta	PVL 6388	Daza *et al.*, 2012	
Pardinamys humahuaquensis	PVL 6316	Ortiz *et al.*, 2012	
Pucatherium parvum	PVL 6398	Herrera *et al.*, 2012	
Pampahippus secundus	PVL 6426	Deraco & García-López, 2015	
Gaimanophis powelli	PVL 6547	Albino, 2017	
Powellvenator podocitus	PVL 4414-1	Ezcurra, 2017	
Lumbreratherium oblitum	PVL 4262	Herrera *et al.*, 2017	
Tucmanableps cionei	PVL 2412	Sferco *et al.*, 2017	
Sachajenynsia pacha	PVL 7036	Sferco *et al.*, 2017	
Toxodon caravela	PVL 6579	Armella *et al.*, 2018	
Rodcania kakan	PVL 7583	Gelfo *et al.*, 2020	
Sebecus ayrampu	PVL 2606	Bravo *et al.*, 2021	
Philander massoiai	PVL 3118	Goin, 2021	

Figure 21. The **PVL** collection today. **1,** Drawer with mammals of the Colección Rusconi; **2,** Drawer with fishes from the La Cantera Formation, San Luis Province; **3,** Shelves with dinosaur material; **4,** General view of drawers and shelves; **5,** Shelves with remains of the dinosaur ***Piatnitzkysaurus floresi***.

Figure 22. 1, Last photo of Jaime E. Powell on a field trip at Sierra de la Candelaria, Salta Province in October 2015. From left to right: Jaime E. Powell, the geologist Pablo Alonso-Muruaga, Rodrigo González, Daniel García-López, Vanessa Torres Carro, and Carolina Madozzo-Jaén; **2,** Last visit of José F. Bonaparte to the **PVL** in April 2018. From left to right: the geologist Florencio G. Aceñolaza, José F. Bonaparte, Rodrigo González, Pablo E. Ortiz, and Fernando Abdala.

Much remains to be done, especially regarding spaces, furniture, staff, and building infrastructure to house the increasing collections. Despite the efforts of many teachers and researchers over the decades, the enormous scientific and educational importance of the PVL collection has not yet triggered the interest of the authorities of the local university and the Tucumán government. This is precisely the challenge that the current generation of paleontologists has to make to the authorities with decision-making power, as an effective way of honoring the great legacy left by Osvaldo Reig, José Bonaparte, and Jaime Powell (Fig. 22).

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CARLOS RUSCONI, A PIONEER IN PALEONTOLOGICAL KNOWLEDGE AND HERITAGE PROTECTION IN MENDOZA PROVINCE, ARGENTINA

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Abstract. The naturalist Carlos Rusconi firstly became in contact with important paleontologists such as Carlos Ameghino and Lucas Kraglievich in the Museum of Buenos Aires. Together with Lorenzo Parodi and Alfredo Castellanos, he formed an incipient group of vertebrate paleontologists. After the dispersion of this group at the end of 1930, Rusconi began to work at the Jardín Zoológico of Buenos Aires. Few years later, he was the Director of the provincial museum of Mendoza city, where he worked for 30 years. During this period, the Museo de Historia Natural of Mendoza experienced a great development, not only as an educational but also as a research institution. Rusconi recovered a significant paleontological collection mainly from Mendoza and close areas in the Cuyo Region. He reorganized the museum in different departments and started new inventory books. He published numerous articles on paleontology, among which those on Paleozoic trilobites and graptolites, Jurassic marine reptiles, and Triassic amphibians and fishes are greatly relevant. He defined a large number of new taxa, which are reflected in the numerous type materials stored at the museum. Rusconi worried about the paleontological heritage and even published a draft bill promoting a law to protect paleontological and archeological sites in Mendoza Province. The lack of provincial support to adequately maintain the museum and its collections led Rusconi to resign as Director in 1967. Despite his controversial personality and scientific isolation, Rusconi's legacy in paleontology cannot be denied or ignored, especially when dealing with the paleontological record of Mendoza.

Key words. Paleontology**.** History. Cuyo Region. Central-western Argentina.

Resumen. CARLOS RUSCONI, UN PIONERO EN EL CONOCIMIENTO PALEONTOLÓGICO Y LA PROTECCIÓN DEL PATRIMONIO EN LA PROVINCIA DE MENDOZA, ARGENTINA. El naturalista Carlos Rusconi tuvo contacto con importantes paleontólogos como Carlos Ameghino y Lucas Kraglievich en el Museo de Buenos Aires. Junto con Lorenzo Parodi y Alfredo Castellanos, formó un grupo incipiente de paleontólogos de vertebrados, pero se dispersó a finales de 1930 y Rusconi empezó a trabajar en el Jardín Zoológico de Buenos Aires. Pocos años después, le ofrecieron la dirección del Museo provincial de la ciudad de Mendoza, donde trabajó durante 30 años. El Museo de Historia Natural de Mendoza experimentó entonces un gran desarrollo, tanto a nivel educativo como de investigación. Rusconi formó una colección paleontológica significativa, principalmente de Mendoza y otras áreas cuyanas. Organizó el museo en distintos departamentos e inició nuevos libros de inventario. Publicó numerosos artículos sobre paleontología, entre los cuales destacan los dedicados a trilobites y graptolites paleozoicos, reptiles marinos jurásicos y peces y anfibios triásicos. Definió un gran número de taxones nuevos, lo cual se refleja en el gran número de materiales tipo incluidos en la colección. Rusconi se preocupó por el patrimonio paleontológico e, incluso, publicó un proyecto de ley para la protección de los yacimientos paleontológicos y arqueológicos de la provincia de Mendoza. La falta de apoyo provincial para mantener adecuadamente el museo y sus colecciones llevó a Rusconi a renunciar como director en 1967. A pesar de su personalidad controvertida y su aislamiento científico, el legado de Rusconi en la paleontología no se puede negar ni ignorar, especialmente en lo que concierne al registro paleontológico de Mendoza.

Palabras clave. Paleontología. Historia. Región de Cuyo. Centro-oeste argentino.

THIS CONTRIBUTION deals with the influence of the naturalist Carlos Rusconi in the development of Argentinean paleontology during a great part of the 20th century, especially in the Mendoza Province between 1937 and 1967.

FIRST STEPS AS A PALEONTOLOGIST

Carlos Rusconi was born at the end of the 19th century (in 1898), within a family of low-income Italian immigrants. His first vocation was artistic, mainly focused on drawing and painting. His enrollment at the Academia de Bellas

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Artes of Buenos Aires was denied because he did not finish elementary school. At the same time, reading the book *La antigüedad del hombre en el Plata* by Florentino Ameghino, arose his curiosity and interest in paleontology. In 1917, Rusconi arrived at the Museo Nacional de Historia Natural of Buenos Aires (now Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"), to show what he believed to be some fossil bones, getting then his first interview with Carlos Ameghino, director of the museum at that time. In that opportunity, Ameghino explained to Rusconi that the bones belonged to living animals and showed him how to differentiate them from fossils. Sometime later, Rusconi carried some glyptodont remains recovered from "Loma de Chiclana", the present-day area of Chiclana and Mármol streets in Buenos Aires city (Rusconi, 1965, p. 119). This glyptodont specimen, which belonged to the genus *Neosclerocalyptus*, became then the first specimen of Rusconi's paleontological collection (Fig. 1.1), parallel to another collection of living vertebrates (Fig. 1.2) for comparison (following Carlos Ameghino's suggestion; Rusconi, 1965, p. 119–120).

Since then, Rusconi frequently visited the Museo Nacional de Historia Natural of Buenos Aires and later became adscript *ad honorem* at the Department of Paleontology, living off his job in sculpture atelier. Together with Lorenzo Parodi and Alfredo Castellanos, he formed an incipient group of vertebrate paleontologists under the direction of Carlos Ameghino (Fig. 2.1–2.2) and Lucas Kraglievich, with whom he was able to establish a personal friendship (Fig. 2.3). This close relationship is reflected on the fact that Rusconi kept some of Carlos Ameghino's field notebooks (and even of his brother Florentino), which have been preserved in his family home through time (Fig. 3).

In mid-1924, Carlos Ameghino resigned as the museum's director for health reasons. Later, in 1930,

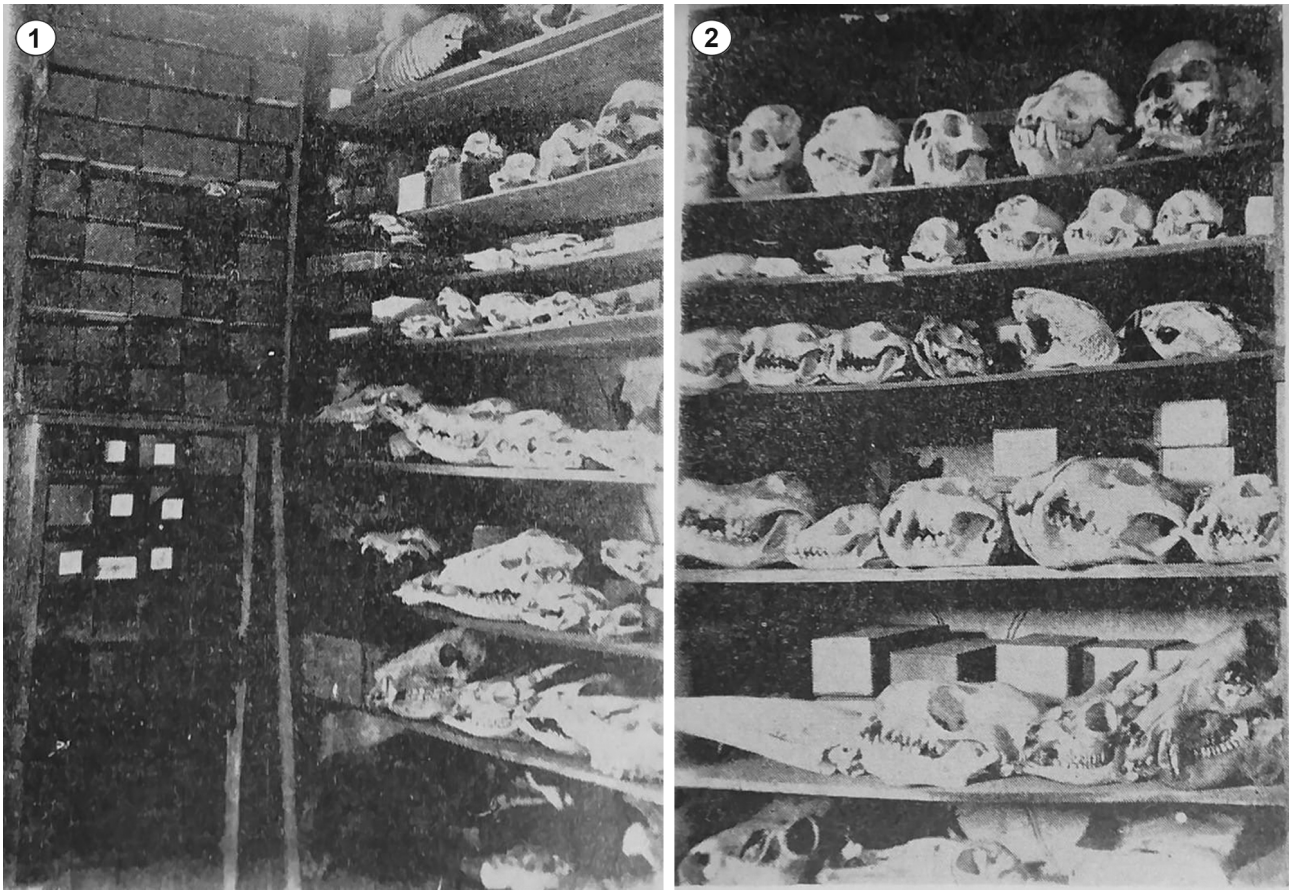
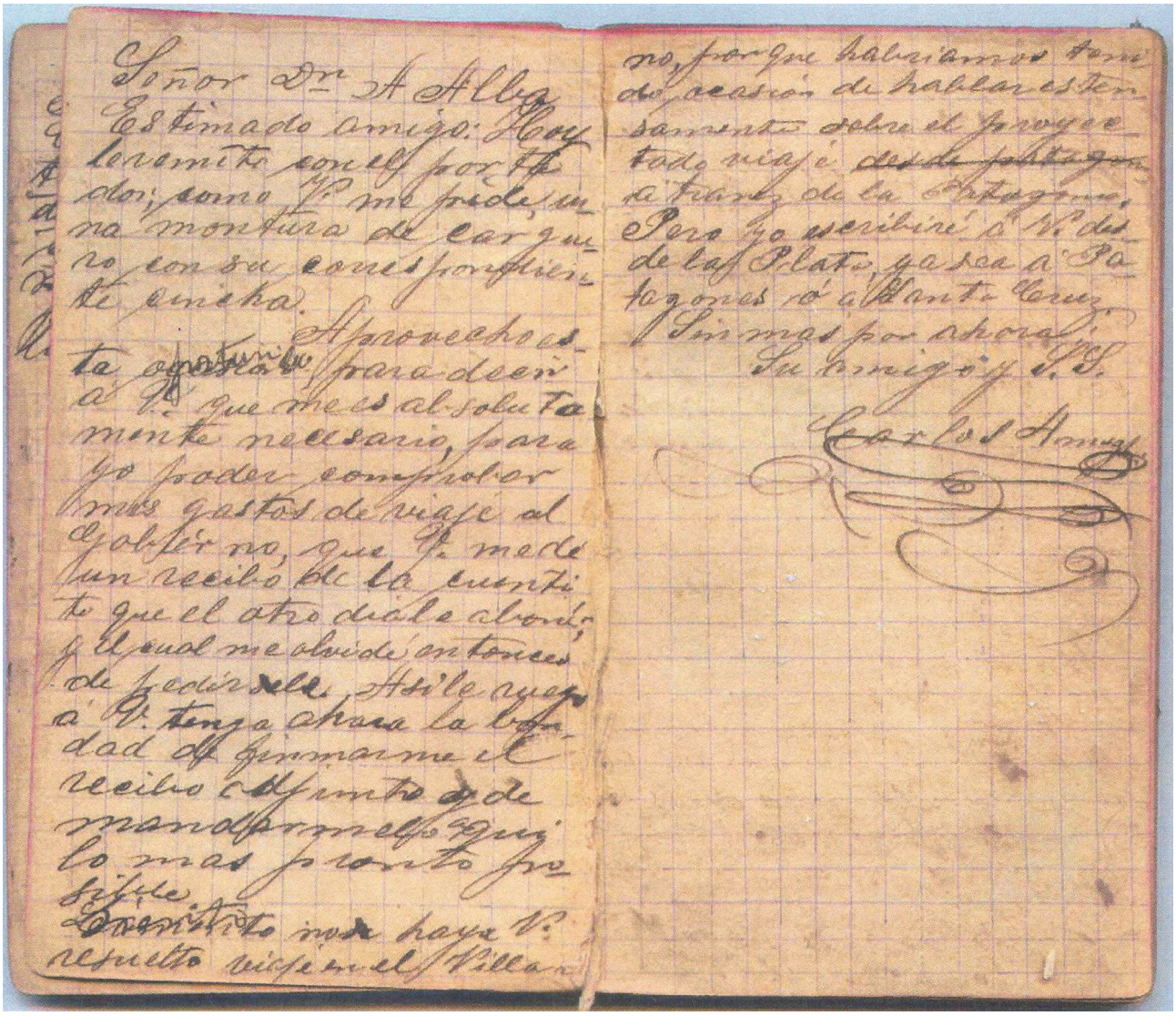


Figure 1. First Rusconi's collections (modified from Mas Alós, 1967). **1,** Fossil specimens; **2,** Living vertebrate skulls.

Figure 2. 1, Carlos Rusconi and Carlos Ameghino (in 1931) (courtesy of Estela Rusconi); **2,** Postcard made by Carlos Rusconi with the photograph of Carlos Ameghino (courtesy of Estela Rusconi); **3,** Carlos Rusconi and Lucas Kraglievich (in 1930) (modified from Rusconi, 1957a, fig. 1).

Kraglievich permanently left the museum. Kraglievich's departure has been the subject of controversy among historians of Argentinean paleontology. Some authors associated his departure to the rivalry with the new director of the museum, Martín Doello Jurado, in the context of the political crisis that Argentina was going through in 1930, due to the military coup that led to the overthrow of Hipólito Yrigoyen (Reig, 1961), even being considered as an act of proscription (Pascual, 1961, p. 95). Other authors, instead, considered it was related to more personal circumstances beyond the historical framework, because in 1928, when Yrigoyen took over his second presidency, Kraglievich expected to be elected as director of the museum, but Doello Jurado was confirmed in his position. Years later, when the military coup took place and taking advantage of the political situation, a group of paleontologists including Rusconi sent a note to the military authorities making harsh charges against Doello Jurado and requesting the intervention of the museum. However, the note was rejected and Doello Jurado revoked the assignments of the members of this group (Tonni *et al.*, 2000). Rusconi interpreted this attitude as retaliation and, shortly after, wrote a note (Rusconi, 1930) with some reflections, such as the lack of institutional support to publish his contributions in the Anales del Museo Nacional de Historia Natural of Buenos Aires. Regardless of any interpretation, the group finally dismembered; Castellanos entered the Instituto de Fisiografía de la Universidad del Litoral (Rosario, Santa Fe Province), Parodi was incorporated to the Museo de La Plata, and Rusconi began to work at the Jardín Zoológico of Buenos Aires in 1932. These events constituted a hinge in the academic life of Rusconi.

Despite leaving the museum and working as part of the scientific team of Mastozoology at the Jardín Zoológico of Buenos Aires, Rusconi continued to dedicate to paleontological research, mostly Cenozoic mammals. Throughout the years, he self-taught several languages in order to be able to understand papers written by foreign paleontologists and created the journals Ameghinia (Fig. 4.1) and Boletín Paleontológico de Buenos Aires (Fig. 4.2) (Reig, 1961). Rusconi published articles related to paleontology, but also to archaeological and extant remains (*e.g.* Rusconi, 1927, 1928, 1929; Kraglievich & Rusconi, 1931). Among his most outstanding articles, he provided the first observations on the Villa Ballester site (*e.g.*, Rusconi, 1934a, 1934b) and geological data of Buenos Aires city (Rusconi, 1937).



Señor Dr. A. Albg
Estimado amigo: Hoy
levanto con el portador, como V. me pide una montura de carguero con su correspondiente ancha.
Aprovecho esta ocasión para decirle a V. que me es absolutamente necesario, para yo poder comprobar mis gastos de viaje al Gobierno, que V. me de un recibo de la cuantía que el otro día le abonó y el cual me olvidé entonces de pedírselo. Hasta luego á V. tenga ahora la bondad de firmarme el recibo adjunto y de mandármelo, que lo mas pronto posible.
Mientras no haya V. respecto viaje en el Villar no, porque habríamos tenido ocasión de hablar extensamente sobre el proyectado viaje ~~desde Patagones~~ á Trenque de la Patagonia. Pero yo escribiré á V. desde la Plata, ya sea á Patagones ó á Santa Cruz.
Sin mas por ahora.
Su amigo y S.S.
Carlos Ameghino

Figure 3. Pages of a notebook signed by Carlos Ameghino (courtesy of Estela Rusconi).

ARRIVAL TO MENDOZA

Having become a renowned naturalist, Rusconi was contacted at the end of 1936 by the authorities of the Mendoza Province (central-western Argentina) with the proposal to take over the direction of the local museum. So, Rusconi arrived to Mendoza city in January 1937, giving place to a long *bonanza* for this museum. One of the first changes he carried out was the name of the institution. Firstly known as Museo Central (or General) Regional (in 1911) and later Museo Educacional and Museo Juan Cornelio Moyano (in 1925), Rusconi established the name Museo de Historia Natural "Juan Cornelio Moyano" in 1937 (*e.g.*, Coleman, 1929; Rusconi, 1957b). In 1975, it took the present name Museo de Ciencias Naturales y Antropológicas "Juan Cornelio Moyano" (formally abbreviated as MCNAM) by resolution of the local government.

Rusconi also began to reorganize the institution into different departments, according to each specialty. One of these was the Paleontological Department, and he started to keep fossil data in three inventory books: Paleoinvertebrates, Paleovertebrates, and Paleobotany.

Along the 30 years at the museum, Rusconi traveled throughout different Argentinean provinces (particularly Mendoza; Fig. 5) and other countries like Chile and Uruguay,

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BOLETIN No. 14

UN NUEVO GUSANO DEL CRETACEO INFERIOR DE MENDOZA

Por Carlos Rusconi

Durante el viaje a los Molles, Sud de Malalhue, realizado por mí en compañía de empleados del Museo, se pudo obtener restos de dos Ictiosaurios así como también varios centenares de amonites y otros moluscos de edad titoniana y neocomiana y cuyo estudio completo ha de aparecer en el futuro ([1] - [2]).

Entre ese material fósil se encontró un trozo de un grande amonite sobre el cual aparecen innumerables vermes que por su escasez en

FIG. 1. — a. *Pincenia gracile* n. g. n. sp. del Jurásico superior de Mendoza. 1 b, sección de otro ejemplar no deformado por presión (1 X 1).

el jurásico y cretáceo de la Argentina, creo útil darlo a conocer bajo el nombre de:

([1]) CARLOS RUSCONI, *Restos de Ictiosaurios del jurásico superior de Mendoza*, en *Boletin Paleontológico de Buenos Aires*, Bol. N° 10, Bs. As. 1938.
([2]) C. RUSCONI, *Nuevo género de Ictiosaurio argentino*, en *Boletin Paleont. de Buenos Aires*, n° 13, Bs. As. 1942.

Figure 4. 1, Front page of a volume of Ameghinia; **2,** First page of Rusconi's article in the Boletín Paleontológico de Buenos Aires.

collecting not only fossils but also archaeological artifacts, anthropological and ethnographical data. He stored a huge number of specimens and produced numerous publications. Among his non-paleontological contributions, the four voluminous books dedicated to native populations of Mendoza in pre and post-colonial times stand out (Rusconi, 1961, 1962a, 1962b, 1962c).

Concerning paleontology, Rusconi authored numerous new taxa, leading to a high number of type specimens at the MCNAM collections (see Cerdeño, 2005 for a summary—only some of the listed types therein do not correspond to Rusconi's authorship—). Most of the type materials published by Rusconi (486 holotypes and 220 paratypes) correspond to many groups of invertebrates (Cerdeño, 2005). They belong to brachiopods, bivalves, conchostracans, trilobites, graptolites, and others (*e.g.*, Rusconi, 1945, 1949a, 1952, among many others; see further references

Figure 5. Carlos Rusconi during fieldwork in La Colonia area (Junín, Mendoza, in1939) (courtesy of **MCNAM**).

in Cerdeño, 2005). Among the vertebrates (*i.e.*, fishes, amphibians, reptiles—including an ichnofossil—, and mammals), 33 holotypes (Fig. 6.1–6.2) and two paratypes were located after revising the museum paleontological collections, while another 20 could not be found (Cerdeño, 2005). However, three of these were later (2002 and 2006) recovered from other institutions; two of them corresponded to Rusconi's specimens (see Agnolín & Pais, 2006 for *Cunampaia simplex* Rusconi, 1946a, and Lorente *et al.*, 2014 for *Allalmeia atalaensis* Rusconi, 1946b), while the third recovered holotype was not described by him (*Adiantoides leali* Simpson *et al.*, 1962; see Cerdeño, 2005, p. 12). Finally, six type specimens correspond to fossil plants (Rusconi, 1948, 1950, 1951, 1954, 1955a, 1955b) from different localities near Mendoza city, all assigned to Algae of Cambrian, Ordovician, or Silurian ages; only one of the paleobotanical types was not found within the collection (Cerdeño, 2005, p. 54).

As he previously did in Buenos Aires, Rusconi created a new journal, Revista del Museo de Historia Natural of Mendoza, where almost all published papers were of his own authorship. The journal was published between 1947 and 1967, comprising 19 volumes. He even published a draft bill promoting a law to protect paleontological and archeological sites in Mendoza (Rusconi, 1964).

Rusconi had a long-term collaborator at the museum, Professor Manuel Tellechea, who often travelled with him, mainly focused on collecting rocks and minerals, but also fossils. Part of the material collected remained at the museum, but another part constituted his private collection. The latter was only recently (in 2006) stored at the MCNAM (Devincenzi, 2017).

During the late 1960s, Rusconi failed in getting greater support from provincial authorities to maintain the museum and he finally resigned as Director in 1968. He died in Mendoza in 1969.

RUSCONI'S LEGACY

Carlos Rusconi changed the educational profile of the museum towards a research center, trying to emulate those in La Plata, Buenos Aires, and Rosario, where paleontological research was concentrated at that epoch with paleontologists such as Ángel Cabrera, Mathilde Dolgopol, Alejandro Bordas, Noemi Cattoi, and Alfredo Castellanos (Pascual, 1961, p. 97).

Concerning vertebrates, Rusconi began to study groups other than mammals, contrary to what he mainly had done in Buenos Aires. In this sense, as Cabrera did in the Museo de La Plata (Pascual, 1961), Rusconi contributed to the knowledge of the paleoherpetological fauna of Mendoza, which was mostly unknown at that time (summarized data in Cerdeño *et al.*, 2022). In turn, as expressed by Riccardi (1981, 2005), Rusconi deserves a particular acknowledgment for his studies on paleoinvertebrates between 1947

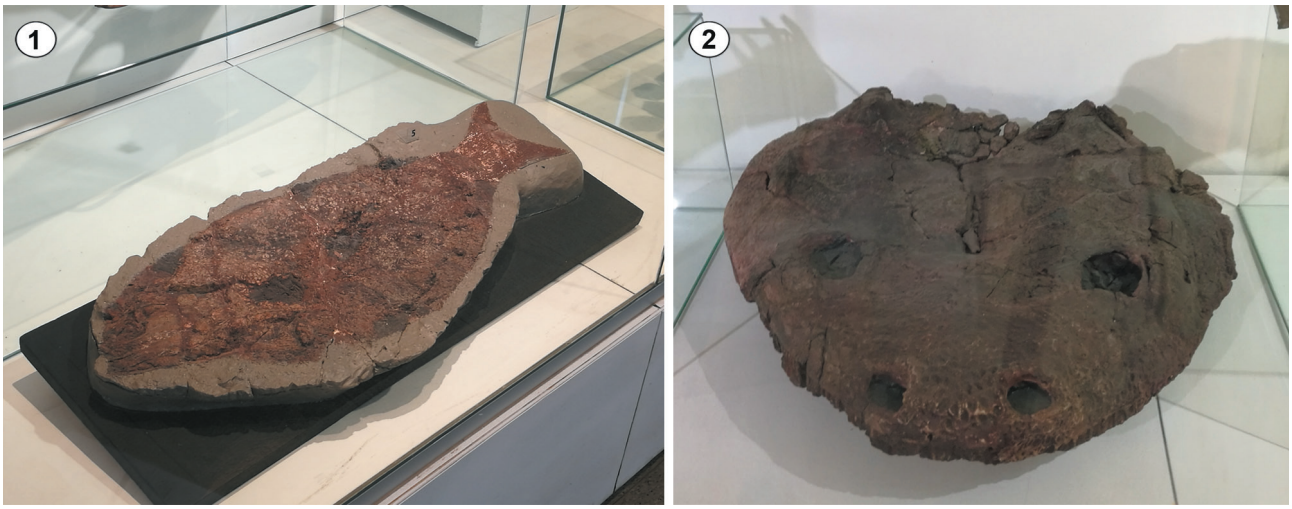

Figure 6. Specimens from the Triassic of Mendoza described by Rusconi, exhibited at the **MCNAM**. **1,** ***Challaia magna*** Rusconi, 1949c, holotype **MCNAM-PV 2790**, fish; **2,** ***Pelorocephalus tenax*** (Rusconi, 1949b), holotype **MCNAM-PV 2752**, amphibian, articulated skull and mandible.

and 1955, an epoch in which the publications on this wide group of organisms had greatly decreased in Argentina, mainly when Joaquín Frenguelli moved away from the Museo de La Plata (Riccardi, 1981, p. 20). Finally, with respect to paleobotany, his contributions were scarce: the petrified forests of Mendoza and the described taxa of Algae mentioned above (see Cerdeño, 2005 and Devincenzi, 2014 for a summary and references therein).

The research activities in the museum of Mendoza stopped when Rusconi resigned, as he never trained disciples and worked without collaborative links with the most important scientific centers in the country (Reig, 1961). Some of his colleagues criticized some aspects of his scientific methodology as a result of his isolation, which, according to Pascual (1961), was driven by the criticism received to some of his papers. He was also criticized for his strong personalism that, among other facts, did not allow other authors to publish in the Revista del Museo de Historia Natural of Mendoza. Consequently, the period of splendor of the institution unfortunately ended and fell into disgrace. Rusconi stood out for his tireless work but also for his controversial personality. Prestigious paleontologists left their acknowledgement in the golden book of the museum (Fig. 7.1–7.3).

Rusconi was recognized as a great popularizer scientist. He published two interesting books. One deals with the animal life at the end of Tertiary in Buenos Aires (Rusconi, 1933), which is considered by Martinelli *et al.* (2020) as one of the icons of the popularization of paleontology in Argentina. The second book focused on extinct animals from

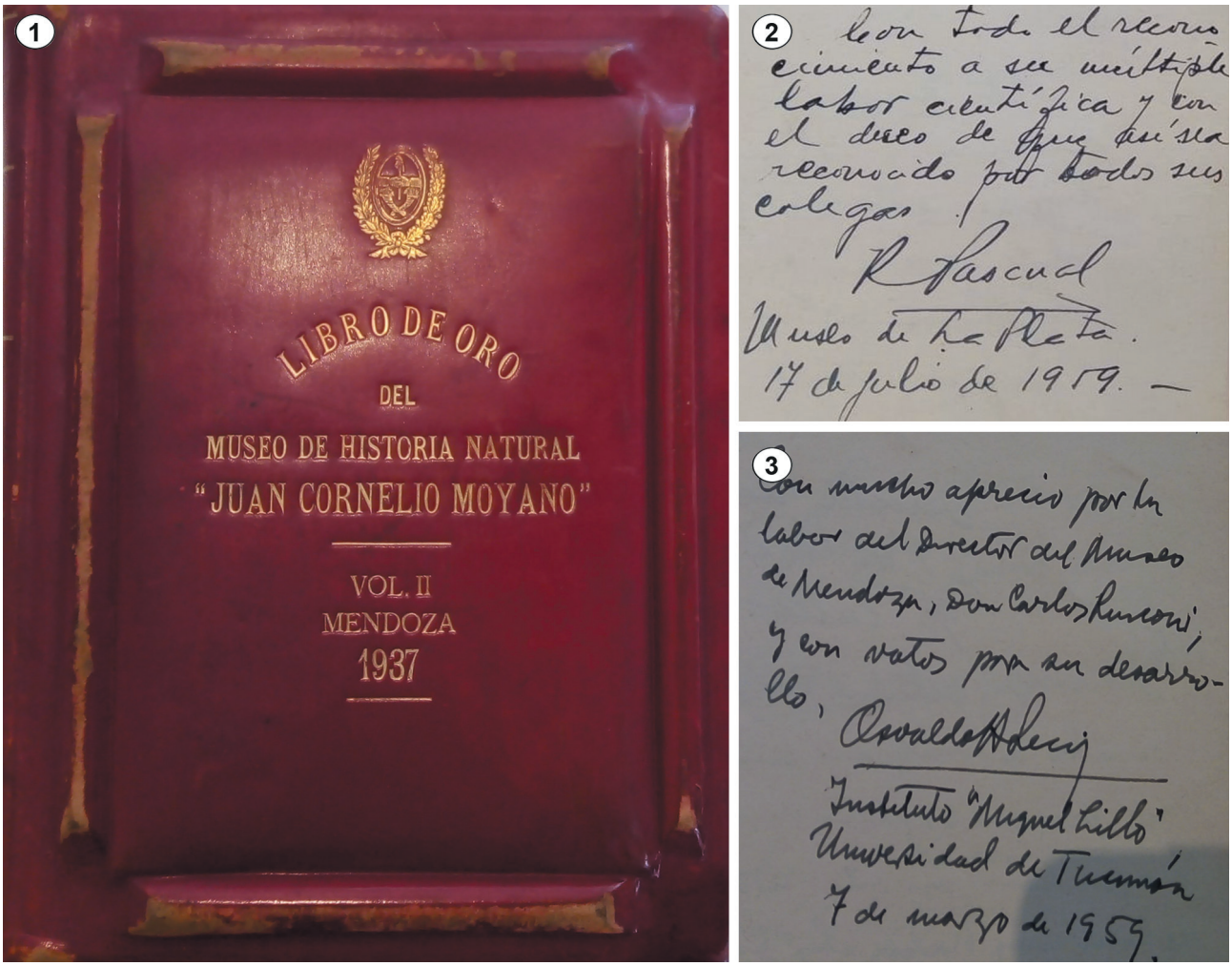

Figure 7. 1, *Libro de Oro* (golden book) of the Museo de Historia Natural "Juan Cornelio Moyano" (currently **MCNAM**) from 1937; **2–3,** acknowledgement notes in 1959 by researchers Rosendo Pascual and Osvaldo Reig.

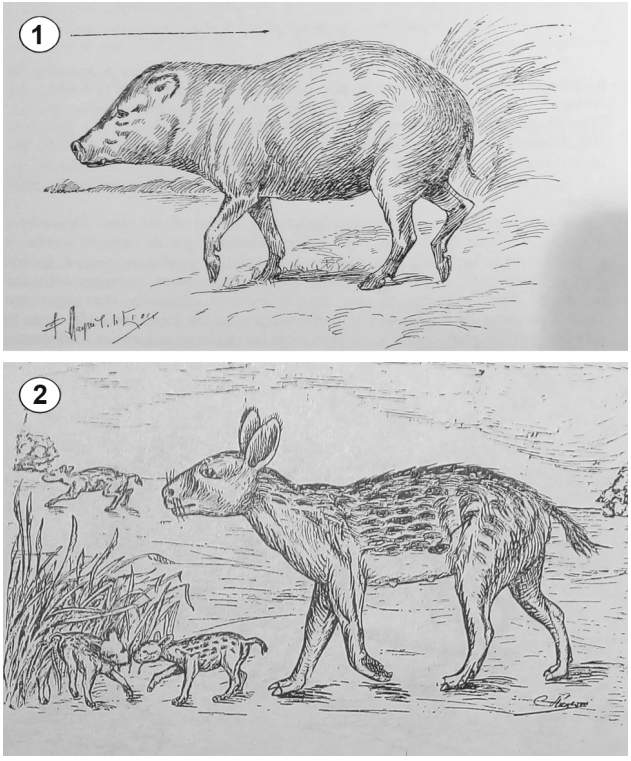

Figure 8. 1, Illustration of ***Catagonus metropolitanus*** by Paul Magne de la Croix (modified from Rusconi, 1967, fig. 267); **2,** Illustration of ***Paedotherium imperforatum*** by Carlos Rusconi (modified from Rusconi, 1967, fig. 248).

Mendoza in particular, and Argentina in general (Rusconi, 1967), illustrated by the French artist Paul Magne de la Croix and by himself (Fig. 8.1–8.2), thus expressing his artistic profile (Martinelli & Forasiepi, 2008; Martinelli *et al.*, 2020).

Finally, it is important to highlight that organizing the MCNAM collections between 2000 and 2004 allowed the revision in subsequent years of many specimens by different specialists, particularly those formerly studied by Rusconi. For example, graptolites were revised by Toro & Brussa (2001, 2007); trilobites by Bordonaro & Fojo (2011) and Tortello (2014); fishes by López Arbarello *et al.* (2010); amphibians and reptiles by Desojo *et al.* (2002), Marsicano *et al.* (2004), Herrera *et al.* (2015), and Fernández *et al.* (2019), among others (see Cerdeño *et al.*, 2022 for a summary); and mammals by López (2008) and Lorente *et al.* (2014).

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THE ANTARCTIC FOSSIL VERTEBRATE COLLECTION OF THE MUSEO DE LA PLATA: HISTORICAL PERSPECTIVE OF FOUR DECADES OF EARTH SCIENCES INVESTIGATIONS IN ANTARCTICA

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Abstract. The Museo de La Plata (MLP, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata) houses Antarctica's largest fossil vertebrate collection. This collection is a major international research resource and constitutes one of Antarctica's most important records of vertebrate history and evolution. The principal focus of this collection is on vertebrate fossils from the Antarctic Peninsula (Late Cretaceous and Paleogene of the James Ross Archipelago, NE Antarctic Peninsula and the Jurassic of the Antarctic Peninsula). The collection is estimated to consist of over 32,000 specimens, including fossils of fishes, anurans, marine reptiles (plesiosaurs and mosasaurs), avian and non-avian dinosaurs, turtles, and marine and terrestrial mammals. The collection comprises many complete and extraordinarily well-preserved skeletons and has 22 holotypes. It also contains several institutional icons, including the skeletons of the elasmosaurid plesiosaur *Vegasaurus* and several non-avian dinosaurs such as *Antarctopelta* and *Trinisaura*, as well as non-avian dinosaurs *Vegavis* and *Conflicto*. The MLP Antarctic fossil vertebrate collection dates from 1978; its importance lies not only in the fact that it is globally one of the main reference collections of Antarctic paleontological material but also in its high proportion of Mesozoic and Cenozoic faunas, which can be used to understand evolutionary dynamics, continental movements, and climatic changes over the past 80 Ma. The collection was made under the auspices and agreement between the Dirección Nacional del Antártico - Instituto Antártico Argentino and the Museo de La Plata in 1983.

Key words. Antarctic repositories. Vertebrate paleontology. Campaigns. Researchers. Logistics.

Resumen. LA COLECCIÓN ANTÁRTICA DE VERTEBRADOS FÓSILES DEL MUSEO DE LA PLATA: PERSPECTIVA HISTÓRICA DE CUATRO DÉCADAS DE INVESTIGACIONES DE CIENCIA DE LA TIERRA EN ANTÁRTIDA. La División Paleontología de Vertebrados del Museo de La Plata (MLP, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata) alberga la colección de vertebrados fósiles más numerosa de Antártida que se conoce en el mundo. Esta colección es un recurso internacional de investigación y constituye uno de los registros más importante de la historia evolutiva de los vertebrados en Antártida. El núcleo importante de los vertebrados fósiles de esa colección proviene de la península antártica (Cretácico Superior y Paleógeno del archipiélago Ross al NE de la península y del Jurásico marino de la misma). La estimación del número de ejemplares de esta colección es aproximadamente de 32.000 especímenes, incluyendo peces, anuros, reptiles marinos (plesiosaurios y mosasaurios), dinosaurios avianos y no avianos, tortugas y mamíferos marinos y terrestres. La colección contiene una variedad de esqueletos extraordinariamente bien preservados y contiene 22 holotipos. También contiene íconos institucionales como los esqueletos del plesiosaurio elasmosáurido *Vegasaurus* y de dinosaurios no avianos como *Antarctopelta* y *Trinisaura*, como así también de los dinosaurios avianos *Vegavis* y *Conflicto*. La colección antártica de vertebrados fósiles data del año 1978 y su importancia no solamente radica en que mundialmente es una de las colecciones de referencia en cuanto a material paleontológico, sino que también su gran acervo en faunas del Mesozoico y Cenozoico pueden ser usados para entender dinámicas evolutivas, movimientos continentales (tectónica) y cambios climáticos de los últimos 80 Ma. La colección de vertebrados fósiles fue realizada bajo los auspicios y convenios desde 1983 entre la Dirección Nacional del Antártico - Instituto Antártico Argentino y el Museo de La Plata.

Palabras clave. Repositorios antárticos. Paleontología de vertebrados. Campañas. Investigadores. Logística.

THE ANTARCTIC VERTEBRATE PALEONTOLOGY collection of the Museo de La Plata (MLP-PV) provides the most complete database for studying Mesozoic and Cenozoic vertebrate life and evolution in the Antarctic Peninsula. This collection represents a major international research resource and constitutes one of the most important records of vertebrate history and evolution in the Antarctic continent.

The first antarctic work carried out in the field by

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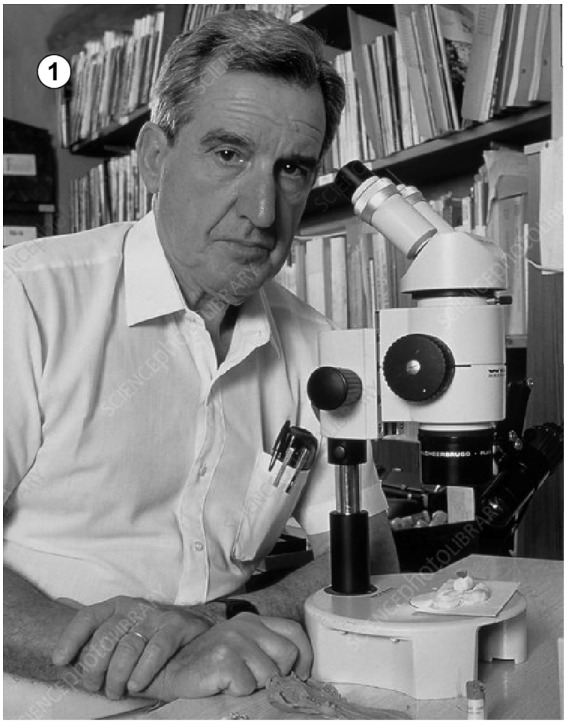
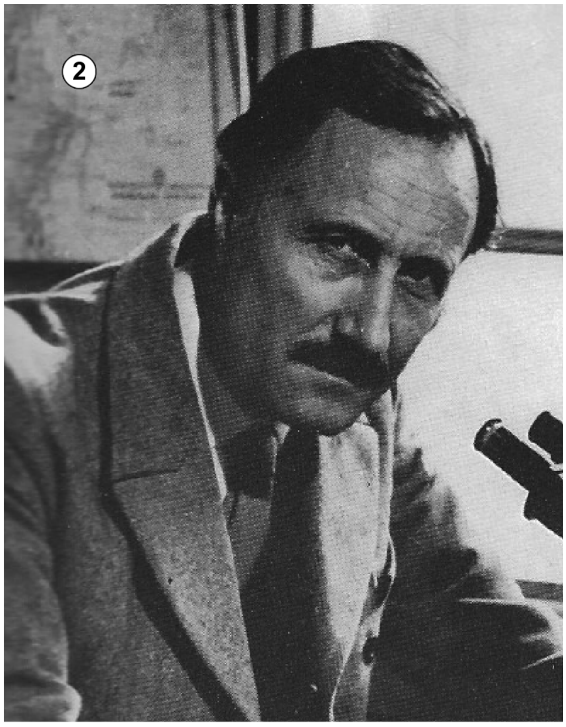
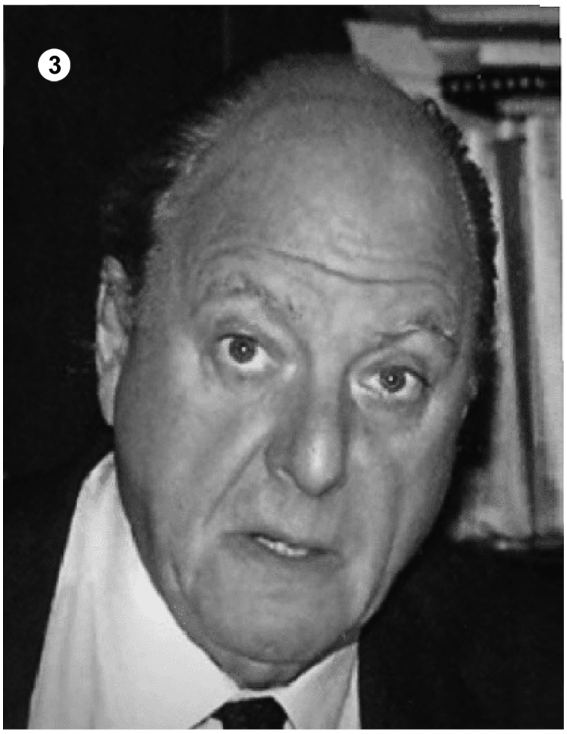


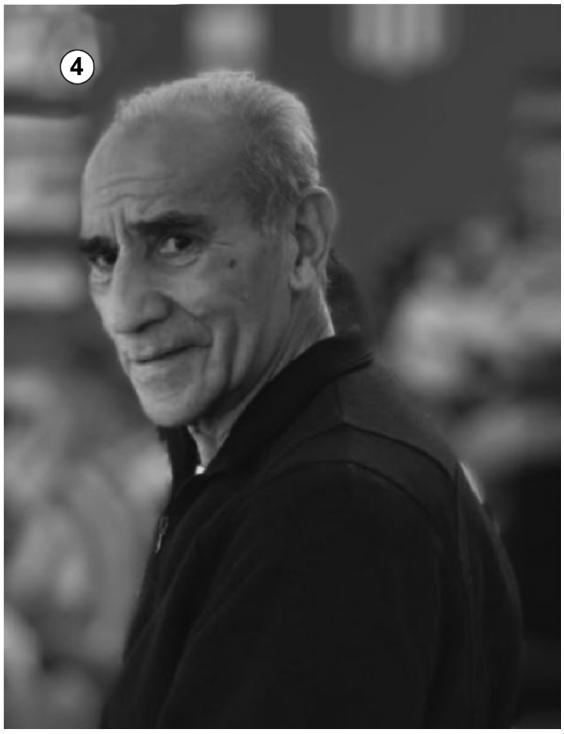
Dr. Rosendo Pascual
(1925 - 2012)



Dr. Néstor Fourcade
(1921 - 2023)



Dr. Carlos A. Rinaldi
(1930 - 2017)



Omar J. Molina
(1937 - 2022)

Figure 1. Relevant authorities and technician (from **MLP** and **IAA**) in the early stages of the formation of the Antarctic fossil vertebrate collection of the **MLP**.

personnel of the MLP began in 1974 under the auspices and invitation of the Dirección Nacional del Antártico (DNA) - Instituto Antártico Argentino (IAA). The DNA is the federal agency in charge of orientating, controlling, addressing, and performing scientific and technical investigations in Antarctica. It depends on the Ministerio de Relaciones Exteriores y Culto (MRECIC).

The first antarctic fossil vertebrate specimens were incorporated into the División Paleontología de Vertebrados (DPV) of the MLP in 1977; being head of this unit Dr. Rosendo Pascual (1923–2012) (Fig. 1.1) (Reguero & Gasparini, 2023).

In 1983, the DNA-IAA and the Universidad Nacional de La Plata (UNLP) signed the first official agreement. This historic agreement emphasized the importance of promoting and supporting antarctic scientific endeavors and stewardship of antarctic paleontological resources with logistics and geologists of the IAA together with vertebrate paleontologists of the MLP. Collaboration between the professional paleontological community of the MLP and the IAA was intended to better serve scientific research on fossils and the preservation of these non-renewable resources. This program of exchange and collaboration in antarctic areas of interest and benefit was established for the convenience of both institutions. The dean of the Facultad de Ciencias Naturales y Museo of the UNLP and the director of the IAA acted as conveners of the parties.

The first Antarctic vertebrate fossil specimens were officially incorporated to the MLP in 1978 (DPV Record Book of Fossil Vertebrates N° 4, p. 63–64, Fig. 2): MLP-PV 78-X-26-1 [410 specimens of Sphenisciformes birds, Chondrichthyes, and teleostean fishes. Marambio (Seymour) Island, collectors: Eduardo Pedro Tonni; Alberto Luis Cione];

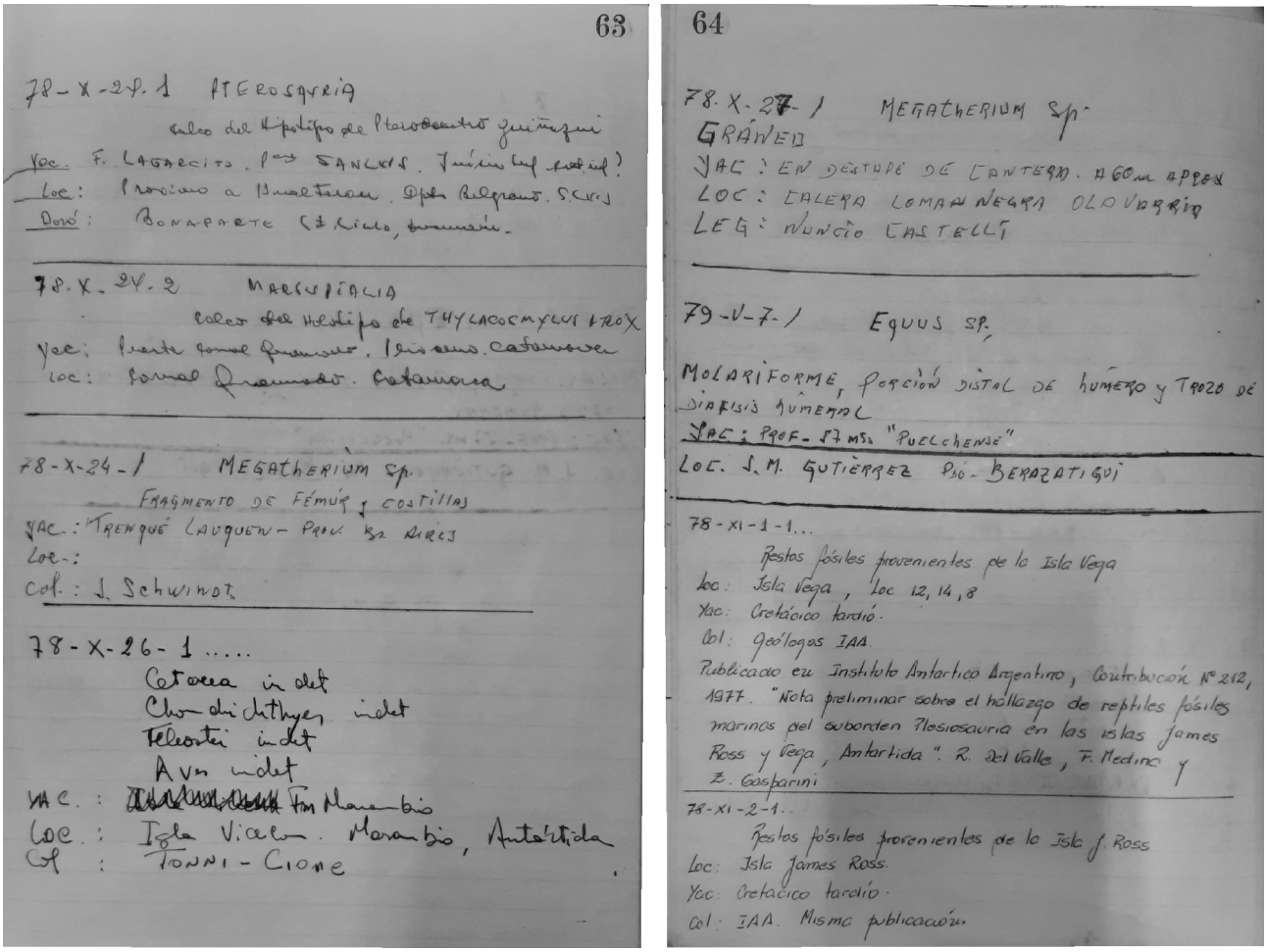


Figure 2. DPV Record Book of Fossil Vertebrates N° 4, copies of the pages 63–64 with the entrance and data of the first antarctic fossil vertebrate collections incorporated to the **MLP**.

MLP-PV 78-XI-1-1 (10 specimens of marine reptiles, Vega Island, collectors: IAA Rodolfo del Valle, Patricio Marshall, Francisco Medina), and MLP-PV 78-XI-2-1 (14 specimens of marine reptiles, James Ross Island, collectors: IAA R. del Valle and F. Medina) (Cione *et al.*, 1977; Del Valle *et al.*, 1977; Tonni & Cione, 1978).

Institutional abbreviations. AT, Antarctic Treaty; **DNA,** Dirección Nacional del Antártico, Argentina; **DPV,** División Paleontología de Vertebrados, Argentina; **FAA,** Fuerza Aérea Argentina, Argentina; **IAA,** Instituto Antártico Argentino, Argentina; **MLP,** Museo de la Plata, Argentina; **MRECIC,** Ministerio de Relaciones Exteriores, Comercio Internacional y Culto, Argentina; **NRM,** Swedish Museum of Natural History, Sweden; **NSF,** National Science Foundation, USA; **SCAR,** Scientific Committee Antarctic Research; **UNLP**, Universidad Nacional de La Plata, Argentina.

Other abbreviations. CAV, *Campaña Antártica de Verano* (Summer Antarctic Fieldwork); **GEOANTAR,** *Programa geológico del Instituto Antártico Argentino* (Geological program of the Instituto Antártico Argentino); **ICG,** International Commission on Geoheritage; **IGY,** International Geophysical Year; **IUGS,** International Union of Geological Sciences; **K/Pg,** Cretaceous/Paleogene boundary; **PAA,** *Plan Anual Antártico*; **SANU,** South American Native Ungulate.

OPENING REMARKS

International context of the fossil vertebrates and collecting activities of Argentina in Antarctica

The AT applies to the entire region south of 60° South latitude. It was signed in Washington on December 1st, 1959 by the 12 countries (including Argentina) whose scientists had been active in and around Antarctica during the IGY, an international scientific project that lasted from July 1st, 1957 to December 31st, 1958. The IGY triggered an 18-month project of antarctic science. The International Council of Scientific Unions broadened the proposals from polar studies to geophysical research. More than 70 existing national scientific organizations then formed IGY committees and participated in the cooperative effort. The AT entered into force on June 23rd, 1961. Today, 54 nations have signed the Treaty—29 of which have voting rights (see http://www.scar.org/policy/antarctic-treaty-system/)—.

Among the signatories of the AT were seven countries—Argentina, Australia, Chile, France, New Zealand, Norway, and the United Kingdom—with territorial claims; other countries do not recognize any claims. The United States and Russia maintain a "basis of claim". It effectively stops nations from making territorial claims or from exploiting Antarctica. All positions are explicitly protected in Article IV, which preserves the *status quo*: "No acts or activities taking place while the present Treaty is in force shall constitute a basis for asserting, supporting, or denying a claim to territorial sovereignty in Antarctica or creating any rights of sovereignty in Antarctica. No new claim or enlargement of an existing claim to territorial sovereignty in Antarctica shall be asserted while the present Treaty is in force".

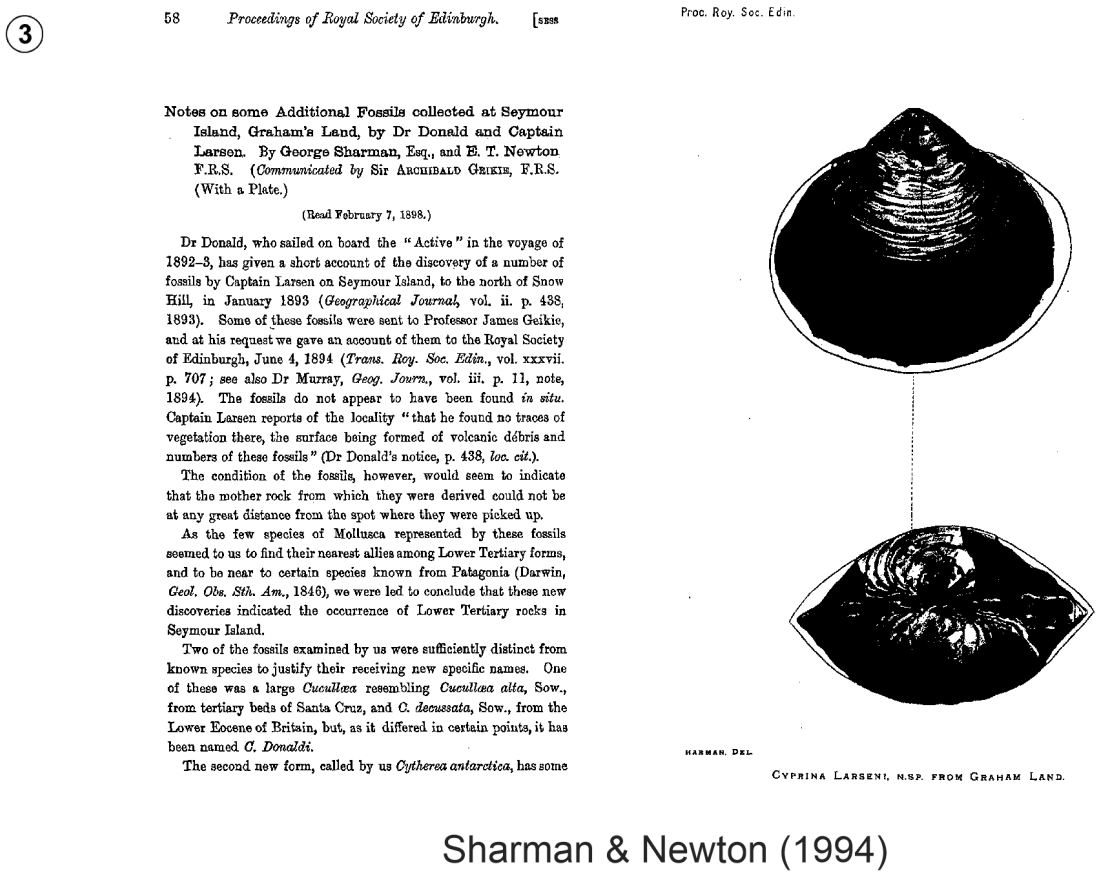
One key science priority of the Argentine Antarctic Program announced to the AT is: "The connections between Antarctica and Argentine South American territory to reveal the intimate biogeographical relationships between both regions, both current and those of the geological past" (https://www.ats.aq/devAS/Ats/KeySciencePriorities?lang=e).

Historical background of the first antarctic fossil vertebrate collections and the Paleontological Heritage legacy of the fossil vertebrates from Antarctica. The Antarctic Peninsula (West Antarctica) is the region that has provided and will likely continue to provide the most informative fossil vertebrate remains from the Mesozoic–Paleogene of this continent. During the past three decades, geological and paleontological explorations of the James Ross Basin (Del Valle *et al.*, 1992), Weddell Sea, have revealed that this basin, located off the northeast tip of the Antarctic Peninsula, contains one of the most important records of Late Cretaceous and early Paleogene life in the Southern Hemisphere. Knowledge of the existence of fossils in Antarctica goes back to the early 19th century, when James Eights (1798–1882) described fossilized wood from the South Shetland Islands *in situ* (Eights, 1833). The first documented collection of marine invertebrate fossils from Antarctica was made by the Norwegian whaling Carl Anton Larsen (1860–1924) (Fig. 3.1), captain of the "Jason" ship (Fig. 3.2) on Marambio (Seymour) Island during the austral summer of 1892–1893 (Larsen, 1894). These fossils were studied and published by Sharman & Newton (1894) (Fig. 3.3).

Since the beginning of the 20th century, the geological and paleontological explorations on Marambio (Seymour)

Carl Anton Larsen
1860-1924

Jason



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Notes on some Additional Fossils collected at Seymour Island, Graham's Land, by Dr Donald and Captain Larsen. By George Sharman, Esq., and E. T. Newton F.R.S. (*Communicated by* Sir Archibald Geikie, F.R.S. (With a Plate.)

(Read February 7, 1898.)

Dr Donald, who sailed on board the "Active" in the voyage of 1892–3, has given a short account of the discovery of a number of fossils by Captain Larsen on Seymour Island, to the north of Snow Hill, in January 1893 (*Geographical Journal*, vol. ii. p. 438, 1893). Some of these fossils were sent to Professor James Geikie, and at his request we gave an account of them to the Royal Society of Edinburgh, June 4, 1894 (*Trans. Roy. Soc. Edin.*, vol. xxxvii. p. 707; see also Dr Murray, *Geog. Journ.*, vol. iii. p. 11, note, 1894). The fossils do not appear to have been found *in situ*. Captain Larsen reports of the locality "that he found no traces of vegetation there, the surface being formed of volcanic débris and numbers of these fossils" (Dr Donald's notice, p. 438, *loc. cit.*).

The condition of the fossils, however, would seem to indicate that the mother rock from which they were derived could not be at any great distance from the spot where they were picked up.

As the few species of Mollusca represented by these fossils seemed to us to find their nearest allies among Lower Tertiary forms, and to be near to certain species known from Patagonia (Darwin, *Geol. Obs. Sth. Am.*, 1846), we were led to conclude that these new discoveries indicated the occurrence of Lower Tertiary rocks in Seymour Island.

Two of the fossils examined by us were sufficiently distinct from known species to justify their receiving new specific names. One of these was a large *Cucullæa* resembling *Cucullæa alta*, Sow., from tertiary beds of Santa Cruz, and *C. decussata*, Sow., from the Lower Eocene of Britain, but, as it differed in certain points, it has been named *C. Donaldi*.

The second new form, called by us *Cytherea antarctica*, has some

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HARMAN, DEL.

CYPRINA LARSENI, N.SP. FROM GRAHAM LAND.

Sharman & Newton (1994)

Figure 3. 1, Carl Anton Larsen; **2,** "Jason" ship; **3,** Sharman & Newton (1894): "Note on some fossils from Seymour Island, in the Antarctic regions, obtained by Dr Donald".

Island have demonstrated that this island contains one of the most important records of Late Cretaceous and Paleogene life in the Southern Hemisphere.

Otto Nordenskjöld (1869–1928) (Fig. 4.1), a Swedish geologist and geographer, led the 1901–1904 Swedish Antarctic Expedition to the Antarctic Peninsula. This expedition was one of the most scientifically successful expeditions in the history of antarctic exploration. Among other scientific results of this expedition is the first fossil vertebrate collection from Marambio (Seymour) Island, Antarctica (Fig. 4.2).

The expedition was under the Norwegian Carl Anton Larsen´s overall command, who served as captain of the "Antarctic" (Fig. 4.3) and had previously commanded a whaling reconnaissance mission in 1892–1893. In October 16th, 1901, the "Antarctic" left Gothenburg, Sweden, and sailed to Antarctica. On the way to Antarctica, the "Antarctic" visited Buenos Aires and the Malvinas Islands before leaving Nordenskjöld's party at Snow Hill Island (Fig. 4.4) off the Antarctic Peninsula to overwinter. Nordenskjöld had passed through Buenos Aires, where the Argentine government gave him supplies and other assistance on the

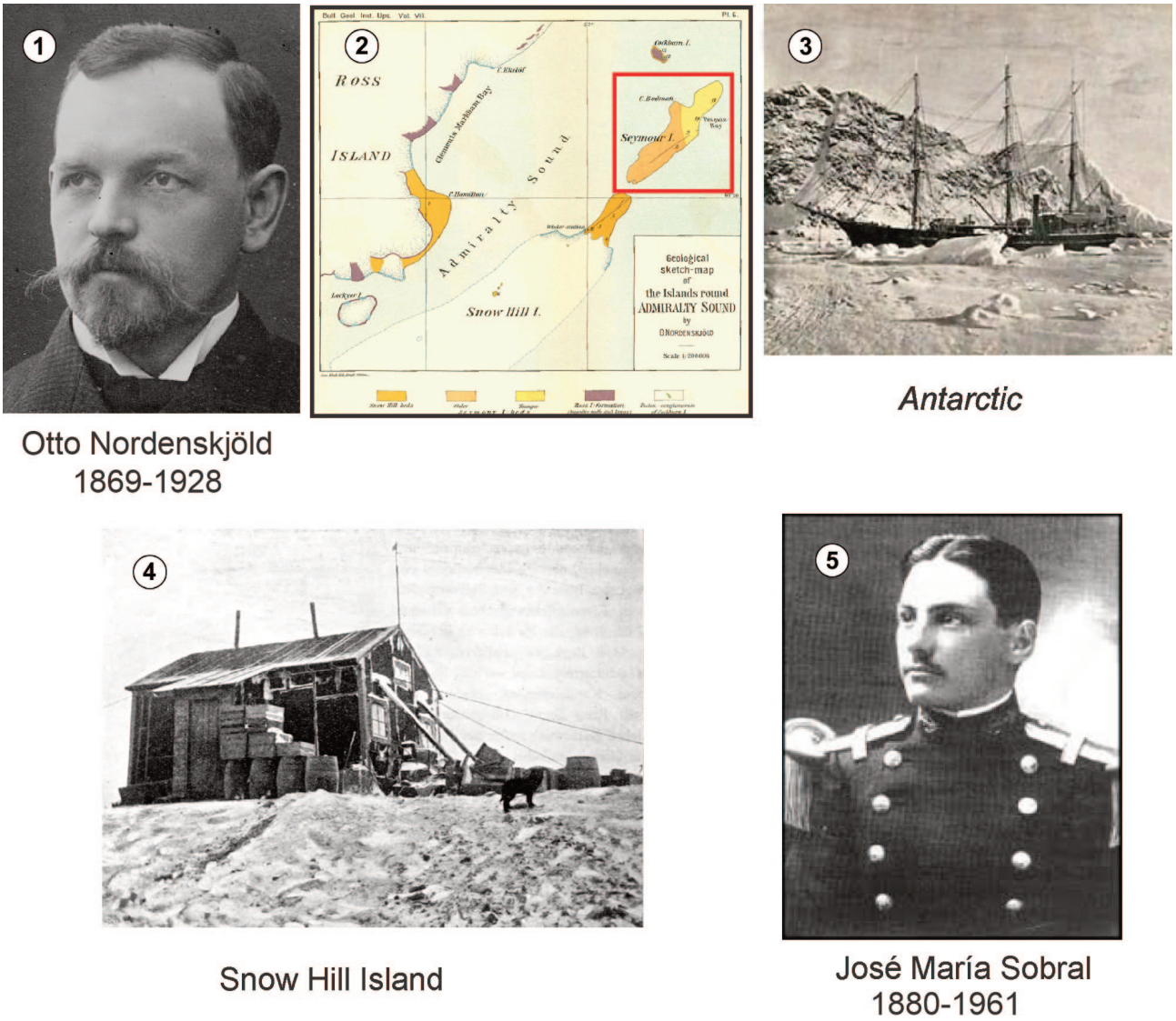

Figure 4. 1, Otto Nordenskjöld; **2,** José María Sobral; **3,** "Antarctic" ship; **4,** Snow Hill Island (Swedish hut); **5,** Geological map of Seymour (Marambio) Island, Antarctic Peninsula drawn by Otto Nordenskjöld (Wiman, 1905b) showing the locality 11 (**DPV 13/84**).

condition that he include in his wintering-over party a young Argentinean naval officer, Lieutenant José María Sobral (1880–1961) (Fig. 4.5).

Early in November 1902, Larsen sailed south to retrieve the party, but the "Antarctic" became trapped in ice and damaged so much that it eventually sank on February 12th, 1903, forcing the crew to winter in a shelter on Paulet Island. In 1903, the Argentine government organized a rescue with the corvette "ARA Uruguay", which successfully brought back all the surviving members of the Nordenskjöld party and the crew of the "Antarctic".

The Swedish South Polar Expedition was the first collector of antarctic vertebrate fossils on Marambio (Seymour) Island. The site was indicated as 'fossil locality no. 11' on Nordenskjöld's map (Fig. 4.2). It is about 50 m above sea level between the northeast coast and the 190 m high plateau, occupying a major part of the island's northeast. The area forms a smoothly undulating expanse covering 100 m in length and width (see Wiman, 1905a, p. 2; 1905b, p. 248). This locality (loc. 11 or currently known as DPV 13/84) has been revisited by earth scientists many times since the 1980s (Acosta Hospitaleche *et al.*, 2017)

Figure 5. 1, Carl Wiman; **2,** Wiman's publication (1905): "*Über die alttertiären Vertebraten der Seymourinsel. Wissenschaftliche Ergebnisse der Schwedischen Südpolar Expedition 1901-1903*". Original cover page of the contribution; Plate 1 (TAF. I.) showing two vertebrae of ***Zeuglodon*** sp. and Plate 2 (TAF. II.) showing tarsometatarsi of "***Eospheniscus gunnari***" (1, 1a), ***Delphinornis larsenii*** (2, 2a), ***Anthropornis nordenskjoeldi*** (3, 3a), ***Spheniscus*** sp. (4, 4a), and ***Ichtyopteryx gracilis*** (5, 5a); **3,** Florentino Ameghino; **4,** Ameghino (1905): "*Enumeración de los Impennes Fósiles de Patagonia y de la Isla Seymour*"; **5,** Marambio (Seymour) Island fossil penguins collected by the Swedish South Polar Expedition (1901–1903) and described by Wiman (1905a): **a.** ***Palaeuudyptes gunnari***, **NRM A.7**, holotype, incomplete tarsometarsus; **b.** ***Delphinornis larseni***, **NRM A.21**, holotype, incomplete tarsometatarsus; **c.** ***Ichtyopteryx gracilis***, **NRM A.20**, incomplete tarsometatarsus; **d.** ***Anthropornis nordenskjoeldi***, **NRM A.45**, holotype, incomplete tarsometatarsus. Scale bar= 5 cm.

and it is one of the most productive paleontological sites in Antarctica (Acosta Hospitaleche *et al.*, 2013, 2019a, 2019b; Reguero *et al.*, 2013a; Reguero, 2019). Carl Wiman (1867–1944) (Fig. 5.1) was the first scientist who described and figured the fossil vertebrates collected by the Swedish South Polar Expedition (Wiman, 1905a). The same year, Florentino Ameghino (1953–1911) (Fig. 5.3) published in his "*Enumeración de los Impennes Fósiles de Patagonia y de la Isla Seymour*" (Ameghino, 1905) (Fig. 5.4) a critic about the Antarctic Sphenisciformes described by Wiman (Fig. 5.5). The Swedish Antarctic collection included about 30 bones, all of which were found weathered out of the rock, thus with no apparent association.

After the Swedish South Polar Expedition (1901–1903), more than 40 years passed before the James Ross Basin was scientifically visited again, this time by members of the Falkland Islands Dependencies Survey (now British Antarctic Survey) in 1946. This was Antarctica's second fossil vertebrate collection (Marples, 1953). It consisted of some 45 specimens.

The establishment of the Marambio Station and its airstrip on Marambio (Seymour) Island in 1969 initiated the modern phase of geologic and palaeontologic investigations in the James Ross Basin (Fig. 6). As Elliot (1988, Preface, p. x) wrote: "Seymour Island is surely destined to be recognized as one of the more important localities for Cretaceous and Paleogene paleontological research in the Southern Hemisphere, if not the world at large".

Today, fossil vertebrates from Marambio (Seymour) Island (extensive to the James Ross Basin; Fig. 6) are housed in collections of national repositories (museums and universities) of several countries (Tab. 1).

The antarctic fossil vertebrate collection of the MLP is outstanding for two main reasons. The first one includes fishes, marine reptiles, and non-avian and avian dinosaurs from one of the best K/Pg recorded sections (the time interval when non-avian dinosaurs became extinct). Recent discoveries in Marambio (Seymour) Island challenge the view that the K/Pg extinctions were caused solely by a catastrophic asteroid impact. Furthermore, the fossil record in Marambio (Seymour) Island indicates a notable decline in diversity over an extended period preceding the impact event at the end of the Cretaceous (65 Ma). For this reason, this area (K/Pg) was selected as the first Antarctic geosite by the SCAR Geoheritage and Geoconservation (Hughes *et al.*, 2020) and it was included by the ICG of the IUGS as the most representative high latitude K/Pg location and one of the most significant and best exposed globally (https://iugs-geoheritage.org/geoheritage_sites/cretaceous-paleogene-k-pg-transition-at-seymour-marambio-island-

TABLE 1 – National repositories (museums, universities, institutes, *etc.*) housing scientific collections of fossil vertebrates from James Ross Basin, NE Antarctic Peninsula

Nation	Acronym	Repositories
Argentina	MLP IAA-PV	Museo de La Plata, La Plata Repositorio Antártico de Colecciones Paleontológicas y Geológicas, Instituto Antártico Argentino (IAA), Ciudad Autónoma de Buenos Aires
Chile	SGO	Museo Nacional de Historia Natural, Santiago
Brazil	MN	Museu Nacional (MN)-Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro
Sweden	NRM-PZ	Swedish Museum of Natural History, Stockholm
Poland	IB/P/B	Professor Andrzej Myrcha University Nature Centre, University of Bialystok, Bialystok
United Kingdom	BAS	British Antarctic Survey, Cambridge
USA	USNM TTU	Smithsonian National Museum of Natural History, Washington Museum of Texas Tech University, Lubbock

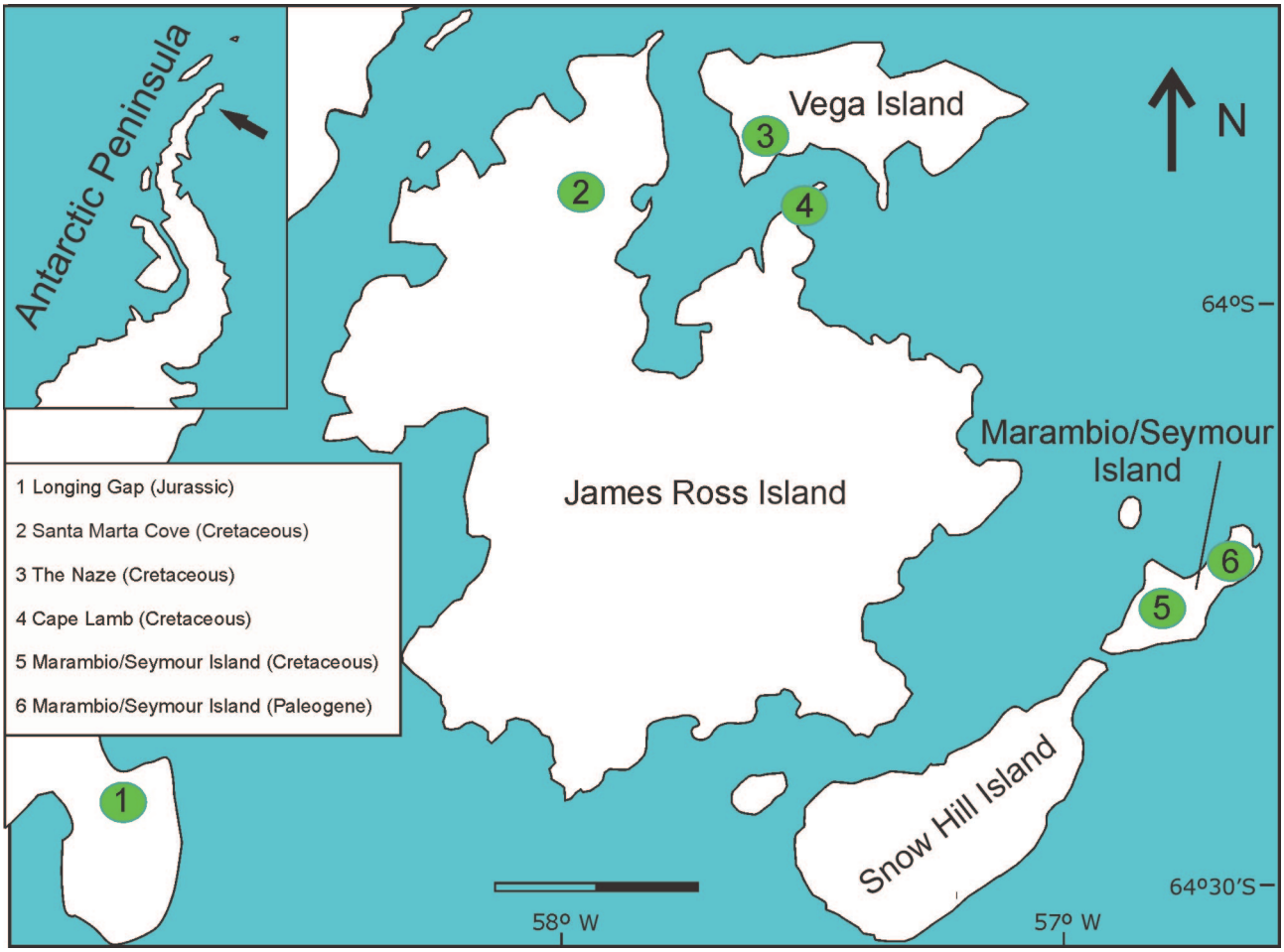

Figure 6. Schematic map of the James Ross Basin, Weddell Sea, northeastern Antarctic Peninsula. Green circles indicate areas worked by the **IAA-MLP** teams. Scale bar= 20 km

antarctica/). The second reason the collection is important is that it helps researchers to understand the effects of current climate change on marine communities in Antarctica since the Jurassic to the Paleogene and even during Holocene times (*e.g.*, Cione *et al.*, 2007; Acosta Hospitaleche *et al.*, 2022).

FIRST AGREEMENT BETWEEN THE DIRECCIÓN NACIONAL DEL ANTÁRTICO AND THE MUSEO DE LA PLATA: EXHIBITION OF THE ANTARCTIC FOSSIL VERTEBRATES OF THE MUSEUM

The first of many agreements was signed in the 1970s between the authorities of the AA, Dr. Néstor Fourcade (1921–2023) (Fig. 1.2), head of the Department of Geology, and Dr. Rosendo Pascual (1925–2012), head of the DPV of the MLP.

Consequently in 1977, it was inaugurated in the museum the "*Sala Antártica*" (Fig. 7), where the public could learn about Antarctic discoveries and what they tell us about the present and past life in Antarctica. This exhibition exhibited the skeleton of a giant fossil penguin found in the Paleogene of Antarctica, on the Submeseta Formation, Marambio (Seymour) Island.

This skeleton (Fig. 8.1) was assembled from the first material collected by the geologist Rodolfo del Valle of the IAA during 1974–1975 (uncatalogued collection CX 60-201-CX 60-322, 121 specimens). Later, these fossils were finally taken out of public display in 1998, when they were moved into storage and returned to the IAA. In 1995, the exhibition of the skeleton of the giant fossil penguin moved to Tokyo, Japan (Fig. 8.2).

Figure 7. Opening of the "*Sala Antártica*" in the **MLP**, 1977.

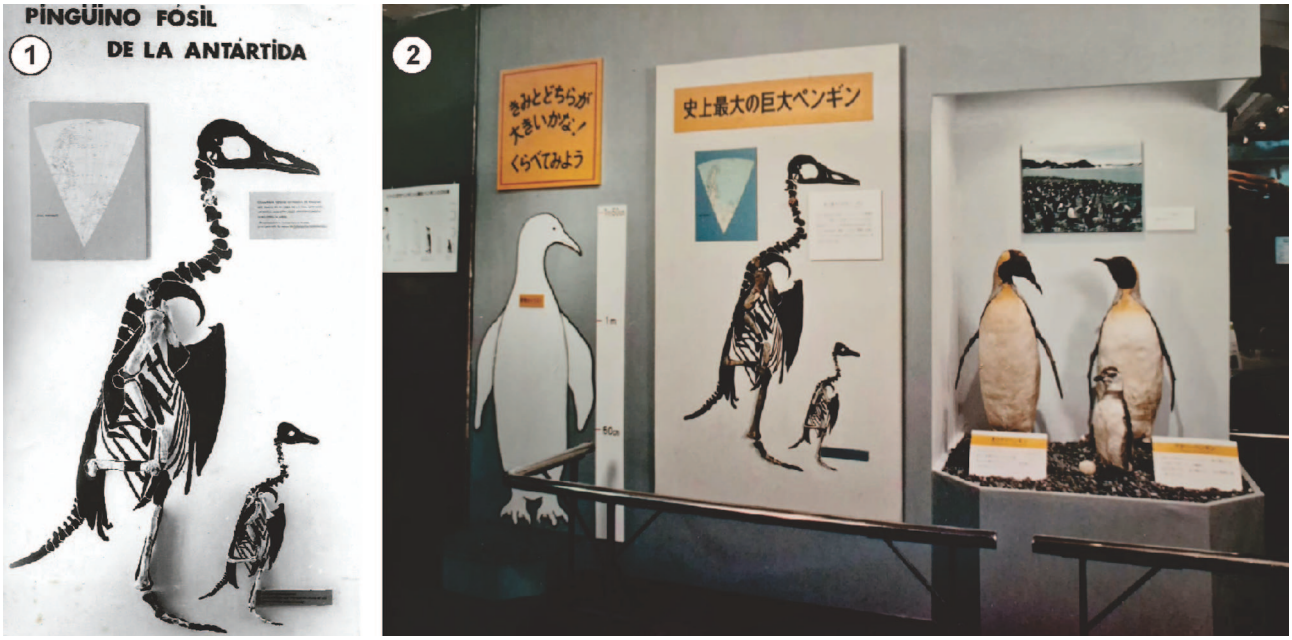

Figure 8. 1, Exhibition of the antarctic giant fossil penguin skeleton in the **MLP,** 1990; **2,** Exhibition of the giant fossil penguin skeleton in the National Museum of Science of Tokio, 1995.

ANTARCTIC VERTEBRATE PALEONTOLOGY COLLECTION OF THE MLP: FOSSIL VERTEBRATE COMPOSITION

The antarctic fossil vertebrate collection of the MLP currently has more than 32,000 specimens that range in age from the Jurassic to the Oligocene and Holocene (Montalti *et al.*, 2009; Acosta Hospitaleche *et al.*, 2022). The collection boasts specimens that collectively represent all major vertebrate groups, including 22 holotypes (Tab. 2), such as those of the iconic non-avian dinosaurs *Antarctopelta oliveroi* (Salgado & Gasparini, 2006) and *Trinisaura santamartaensis* (Coria *et al.*, 2013) and avian dinosaurs *Vegavis iaai* (Clarke *et al.*, 2005; Acosta Hospitaleche & Worthy, 2021), *Conflicto antarcticus* (Tambussi *et al.*, 2019), *Crossvallia unienwillia* (Tambussi *et al.*, 2005; Acosta Hospitaleche *et al.*, 2016), *Aprosdokitos mikrotero* (Acosta Hospitaleche *et al.*, 2017), *Tonniornis mesetaensis*, *Tonniornis minimum* (Tambussi *et al.*, 2006; Tambussi & Acosta Hospitaleche, 2007), and *Notoleptos giglii* (Acosta Hospitaleche & Gelfo, 2015); the plesiosaur elasmosaurid *Vegasaurus molyi* (O'Gorman *et al.*, 2015); SANUs litoptern *Notiolofos arquinotiensis* (Bond *et al.*, 2006) and astrapothere *Antarctodon sobrali* (Bond *et al.*, 2011). This extensive record of extinct vertebrates offers fascinating insights into the history of the Antarctic continent and its biota and has inestimable scientific value. Most of these specimens come from the James Ross Basin, NE of the Antarctic Peninsula (Fig. 6).

The stratigraphic distribution of the taxonomic major groups represented in the MLP antarctic fossil vertebrate collection from Larsen and James Ross basins (Jurassic, Late Cretaceous, and Paleogene), Antarctic Peninsula is shown in Figure 9.

The collection has roughly tripled in size since the late 2000s and the numbers of type and figured specimens have increased accordingly. This growth continued until 2015, as the MLP maintained an active collecting program included in the "*Programa Antártico Argentino*" of the DNA-IAA. Spanning more than 80 million years geologic time, the collection is especially important in Late Cretaceous marine reptiles and avian and non-avian dinosaurs (Reguero *et al.*, 2013a, 2022), turtles, teleostean fishes, and sharks; and Paleogene sphenisciforms (Fig. 10), flying birds, turtles, teleostean fishes, and sharks. Noteworthy individual fossils

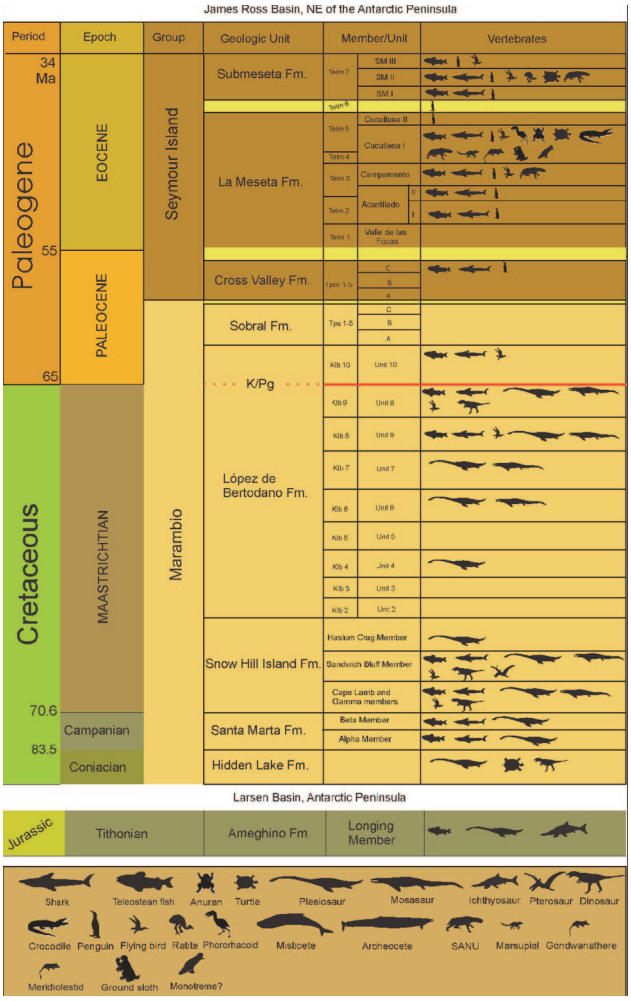

Figure 9. Geology and vertebrate paleontology from Antarctic Peninsula. Time scale, chronostratigraphy and major groups of vertebrate's record for the Jurassic, Late Cretaceous and Paleogene rocks in Larsen and James Ross basins, Antarctic Peninsula. Temporal and sedimentary units not to scale.

or assemblages include a spectacularly diverse and well-represented fauna from the Eocene terrestrial mammals (marsupials, litopterns, astrapotheres, gondwanatheres, and meridiolestids; Reguero *et al.*, 2013b).

Selected highlights of the Antarctic fossil vertebrate collection of the MLP include.:

Late Cretaceous fishes (Cione *et al.*, 2018), mosasaurs, and plesiosaurs taxa from Cape Lamb Member of the Snow Hill Island Formation from James Ross and Vega islands, James Ross Basin. Notable genera include *Edaphodon*, *Vegasaurus*, *Taniwhasaurus*, and *Leiodon* (mosasaurs).

Late Cretaceous iconic dinosaur taxa from Cape Lamb Member of the Snow Hill Island Formation from James Ross

TABLE 2 – MLP Antarctic fossil vertebrate collection: holotypes and type localities from the James Ross Basin, Antarctic Peninsula

Class	Species	Catalog number	Formation	Age	Type locality	References
Chondrichthyes	*Edaphodon snowhilliensis*	MLP-PV 08-XI-30-1	Snow Hill Island	Early Maastrichtian	SMC IAA 2/11, JRI	Gouiric-Cavalli *et al.* (2015)
Dinosauria	*Trinisaura santamartaensis*	MLP-PV 13-I-16-1	Snow Hill Island	Early Maastrichtian	SMC IAA 1/08, JRI	Coria *et al.* (2013)
Dinosauria	*Antarctopelta oliveroi*	MLP-PV 08-III-1-1	Snow Hill Island	Early Maastrichtian	SMC IAA 1/86, JRI	Salgado & Gasparini (2006)
Plesiosauria	*Vegasaurus molyi*	MLP-PV 86-X-28-1	Snow Hill Island	Early Maastrichtian	VEG IAA 2/93, VI	O'Gorman *et al.* (2015)
Aves	*Vegavis iaai*	MLP-PV 93-I-5-1	López de Bertodano	Late Cretaceous	VEG 9303, VI	Tambussi *et al.* (2006)
Aves	*Tonniornis minimum*	MLP-PV 93-I-3-1	Submeseta	Late Eocene	DPV 10/84. MI	Tambussi *et al.* (2006)
Aves	*Toniornis mesetoensis*	MLP-PV 93-I-6-3	Submeseta	Late Eocene	DPV 10/84, MI	Tambussi *et al.* (2006)
Aves	*Crossvallia unienwillia*	MLP-PV 93-X-1-145	Cross Valley	Late Paleocene	IAA 2/04, MI	Tambussi *et al.* (2005)
Aves	*Aprosdokitos mikrotero*	MLP-PV 00-I-10-1	Submeseta	Late Eocene	DPV 16/84, MI	Acosta Hospitaleche *et al.* (2017)
Aves	*Notoleptos giglii*	MLP-PV 00-I-1-19	Submeseta	Late Eocene	DPV 16/84, MI	Acosta Hospitaleche & Gelfo (2016)
Aves	*Conflicto antarcticus*	MLP-PV 12-I-20-305	López de Bertodano	Early Paleocene	IAA 3/06, MI	Tambussi *et al.* (2019)
Aves	*Antarctoboenus carlinii*	MLP-PV 07-III-1-1	La Meseta	Early–Middle Eocene	IAA 2/95, MI	Cenizo *et al.* (2016)
Mammalia	*Derorhynchus minutus*	MLP-PV 95-I-10-8	La Meseta	Early–Middle Eocene	IAA 1/90, MI	Goin *et al.* (1999)
Mammalia	*Pauladelphys juanjoi*	MLP-PV 96-I-5-44	La Meseta	Early–Middle Eocene	IAA 1/90, MI	Goin *et al.* (1999)
Mammalia	*Xenostylos peninsularis*	MLP-PV 95-I-10-2	La Meseta	Early–Middle Eocene	IAA 1/90, MI	Goin *et al.* (1999)
Mammalia	*Perrodelphys coquinense*	MLP-PV 94-III-15-10	La Meseta	Early–Middle Eocene	IAA 1/90, MI	Goin *et al.* (1999)
Mammalia	*Marambiotherium glaciaris*	MLP-PV 96-I-5-11	La Meseta	Early–Middle Eocene	IAA 1/90. MI	Goin *et al.* (1999)
Mammalia	*Woodburnodon casei*	MLP-PV 95-I-10-1	La Meseta	Early–Middle Eocene	IAA 1/95, MI	Goin *et al.* (2007)
Mammalia	*Antarctodolops mesetaense*	MLP-PV 04-III-1-2	La Meseta	Early–Middle Eocene	DPV 6/84, MI	Chornogubsky *et al.* (2009)
Mammalia	*Pujatodon ektopos*	MLP-PV 96-I-5-12	La Meseta	Early–Middle Eocene	IAA 1/90, MI	Goin *et al.* (2018)
Mammalia	*Notiolofos arquinotiensis*	MLP-PV 14-I-10-20	Submeseta	Late Eocene	DPV 16/84, MI	Bond *et al.* (2006)
Mammalia	*Antarctodon sobrali*	MLP-PV 95-I-10-6	La Meseta	Early–Middle Eocene	DPV 2/84, MI	Bond *et al.* (2011)

Abbreviations: JRI, James Ross Island, Antarctic Peninsula; MI, Marambio Island, Antarctic Peninsula; VEG, Vega Island; VI, Vega Island, Antarctic Peninsula

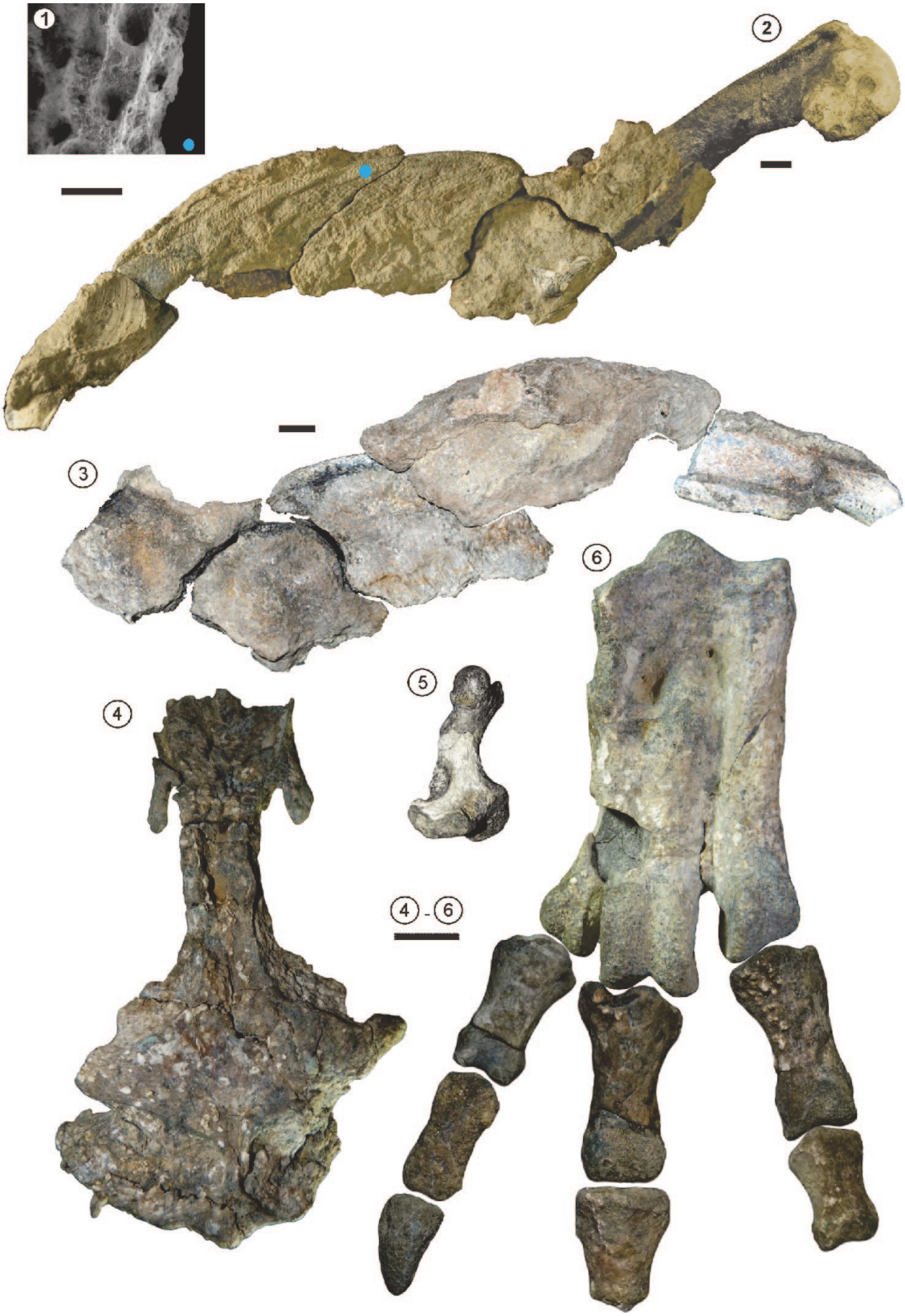

Figure 10. Sphenisciformes: **1–3,** ***Palaeeudyptes gunnari***; **1,** fossilized tegument showing the skin fibres (**MLP-PV 14-I-10-22**); **2–3,** mineralized skin preserving tegument; **4–6,** ***Anthropornis grandis***; **4,** skull; **5,** quadrate; **6,** tarsometatarsus with phalanges (**MLP-PV 14-XI-27-84**). Scale bar= 10 mm

and Vega islands, James Ross Basin. Notable genera include the non-avian dinosaurs *Antarctopelta* and *Trinisaura*.

Late Cretaceous birds from Vega and Seymour (Marambio) islands, such as *Vegavis iaai* (Fig. 11), *Polarornis gregorii*, and many specimens are still under examination (Acosta Hospitaleche *et al.*, 2024).

Late Cretaceous and early Paleocene vertebrates from the K/Pg of Marambio (Seymour) Island, James Ross Basin (Cione *et al.*, 2018; Reguero & Goin, 2021).

Eocene marine vertebrates (fishes, turtles, birds, and whales) from the Paleogene La Meseta and Submeseta formations of Marambio (Seymour) Island, James Ross Basin (Bona *et al.*, 2010; Buono *et al.*, 2016; Cenizo *et al.*, 2016; Acosta Hospitaleche & Gelfo, 2017; Acosta Hospitaleche & Reguero, 2020; Charnelli *et al.*, 2024).

Largest Sphenisciformes of the world (Acosta Hospitaleche & Jadwiszczak, 2011; Acosta Hospitaleche, 2013, 2014, 2016; Jadwiszczak & Acosta Hospitaleche, 2013; Jadwiszczak *et al.*, 2013; Acosta Hospitaleche *et al.*, 2019a, 2019b, 2020) that constitute an almost complete sequence from the late Paleocene to the earliest Oligocene?–latest Eocene (Acosta Hospitaleche & Di Carlo, 2010, 2012; Acosta Hospitaleche & Reguero, 2010, 2011; Acosta Hospitaleche *et al.*, 2012, 2016; Haidr & Acosta Hospitaleche, 2017a, 2017b; Irazoqui & Acosta Hospitaleche, 2021).

Eocene terrestrial vertebrates (anurans, crocodiles, marsupials, litopterns, astrapotheres, gondwanatheres, and meridiolestids) (Goin *et al.*, 1999, 2006; Bond *et al.*, 2006, 2011; Martinelli *et al.*, 2014; Mörs *et al.*, 2020; Bona *et al.*, 2022).

Eocene continental birds (falcons, terror birds, and probably flightless ratites) from the Submeseta and La Meseta formations in Marambio (Seymour) Island (Cenizo *et al.*, 2016; Acosta Hospitaleche *et al.*, 2019a, 2019b; Acosta Hospitaleche & Jones, 2024).

SOURCE OF VERTEBRATE FOSSILS AND ANTARCTIC LOGISTIC

The DNA-IAA provides financial and logistic resources to optimize transportation costs to Antarctica and camping in the field.

FAA supports DNA-IAA campaigns providing plane and helicopter flights (Fig. 12.1–12.2). DNA takes care of camp logistics and clothes (Fig. 12.3–12.4).

DNA-UNLP Agreements and IAA-MLP Protocols:

Since 1983, several agreements and collaboration protocols have been signed between DNA-IAA and MLP (Facultad de Ciencias Naturales y Museo, UNLP); the following documents, among others, have contributed achieving the continuity of the collaboration between these institutions:

In 1983, the DNA - IAA and the MLP signed an official agreement.

In December 2013, the UNLP and the DNA signed the agreement: "*Convenio de Colaboración Recíproca en el Campo de la Investigación Científica y Tecnológica en Materia Antártica entre la Universidad Nacional de La Plata y la Dirección Nacional del Antártico*".

In June 2014, the IAA director, MLP director, and DPV head signed a "*Protocolo de Colaboración*" between these institutions.

In 2019, the IAA and the UNLP-MLP signed a "*Protocolo Específico de Cooperación Académica*".

NATURE AND ORIGIN OF THE ANTARCTIC FOSSIL VERTEBRATE COLLECTION OF THE MUSEO DE LA PLATA

The IAA's first geologic investigations and fieldworks in Marambio (Seymour) Island started in 1974. Doctor R. Pascual from the MLP and Dr. Carlos Rinaldi (1930–2017) (Fig. 1.3), director of the IAA, through a bilateral collaboration, the first antarctic fossils vertebrates were gathered by personnel of the MLP during the IAA GEOANTAR program (1973–1974, 1974–1975, 1975–1976, 1977–1978) geologic campaigns in the James Ross Basin, NE of the Antarctic Peninsula (Fig. 4).

The participation of researchers and technicians of the MLP in the collecting activities in the field of more than four decades (1974–2015) can be resumed in the following four periods: a) IAA GEOANTAR Program 1974–1982; b) DNA-MLP agreement – IAA Paleomarambio 1983–1993; c) DNA-MLP agreement – IAA Geomarambio 1994–2009; and d) Plan Annual Antártico DNA – IAA Paleovertebrados 2010–2015.

Period IAA GEOANTAR Program 1974–1982

The IAA invited the MLP to participate in the IAA

Figure 11. ***Vegavis iaai*** (holotype **MLP-PV 93-I-3-1**); **1,** ninth cervical vertebra in dorsal view; **2,** third thoracic vertebra in cranial view; **3,** fourth thoracic vertebra in caudal view; **4,** coracoid in dorsal view; **5,** left scapula in lateral view; **6,** right humerus in cranial view; **7,** left tibiotarsus in caudal view; **8,** left ulna in ventral view; **9,** radius; **10,** left femur; **11,** right femur; **12,** left humerus in cranial view; **13,** proximal fragment of right humerus; **14,** left *ossa coxae* in medial view; **15,** right *ossa coxae* in lateral view;**16,** proximal right tarsometatarsus; **17,** distal end left tarsometatarsus; **18,** *synsacrum*. Scale bar= 10 mm

Figure 12. 1, Hercules C-130 in Río Gallegos, Santa Cruz loading cargo to flight to Marambio (Seymour) Island; **2,** MI helicopter of the **FAA** repleneshing the "*Casa de Botes*" shelter, Bahía López de Bertodano, Marambio (Seymour) Island; **3,** "*Geomarambio*" camp in Cape Lamb, Vega Island, 2005; **4,** "*Paleovertebrados Jurásico*" camp and shelter in Longing Gap, Antarctic Peninsula, 2015.

GEOANTAR program. In 1974, Omar J. Molina (1937–2022) (Fig. 1.4), chief of technicians of the DPV, was invited by the IAA to visit Marambio (Seymour) Island (Fig. 6). Molina collected a few fragments of Sphenisciformes from the La Meseta Formation (16 specimens, uncatalogued MLP collection) (O'Gorman *et al.*, 2024).

In the summer of 1975, José María Ageitos and Oscar Eduardo Odreman Rivas from the MLP participated in the IAA GEOANTAR program and visited Marambio (Seymour) Island.

In 1977–1978, two vertebrate paleontologists of the MLP, Dr. E.P. Tonni and Dr. A.L. Cione, visited Marambio (Seymour) Island and collected fossil vertebrate specimens, being the first professionals commissioned by the MLP to participate in the fieldworks in Antarctica (Fig. 13.1–13.2). The fossil vertebrates collected by Tonni and Cione were the first antarctic specimens officially incorporated into the DPV-MLP (Cione *et al.*, 1977; Tonni & Cione, 1978).

The fossil vertebrate prospecting, surface collecting, and larger-scale quarrying by personnel from the MLP started in the beginning of 1980s. In the antarctic summer of 1981–1982, the IAA-MLP team prospected the outcrops of the López de Bertodano Formation (Unit 9, Upper Cretaceous, Fig. 13.3) in the south of Marambio (Seymour) Island. This resulted in the recovery of an articulated postcranial skeleton of a non-aristonectine elasmosaurid plesiosaur on January 28th, 1982 (Fig. 13.4). The skeleton of the elasmosaurid was taken back by plane to the MLP by Víctor A. Melemenis, technician of the DPV, and prepared in the laboratories of this institution. It was one of the first plesiosaur articulated skeletons recovered from Antarctica and one of the first collected in quarrying within permafrost.

An initial report was published by Gasparini *et al.* (1984). O'Gorman *et al.* (2021) recently published new data on this skeleton.

Four CAV were done during this period: 1977, 1978, 1979, and 1982. Eight collection transactions were recorded in the DPV Record Book of Fossil Vertebrates: MLP-PV 78-X-26-1, MLP-PV 78-XI-1-1, MLP-PV 78-XI-2-1, MLP-PV 82-I-28-1, MLP-PV 82-IV-23-1, MLP-PV 83-I-12-1, MLP-PV 83-V-20-1, and MLP-PV 83-V-30-1. The number of specimens collected during this period and housed in the MLP is estimated to be 880. Participants /collectors of the IAA-MLP are listed in Table 3.

Period DNA-MLP agreement – IAA Paleomarambio 1983–1989

In January 1986, the geologist Eduardo Bernardo Olivero and his team ("IAA *Bioestratigrafía*") found an almost complete skeleton of a non-avian dinosaur in the marine horizons of the Snow Hill Island Formation (Upper Cretaceous) in the Caleta Santa Marta, James Ross Island.

Figure 13. Period **IAA GEOANTAR** Program 1974-1982; **1–2, GEOANTAR** Program, Paleogene of Marambio (Seymour) Island, Dr. E.P. Tonni prospecting horizon of the La Meseta Formation, paleontologist's team in camp, Marambio (Seymour) Island, 1977; **3–4, GEOANTAR** Program, López de Bertodano, Marambio (Seymour) Island, Víctor A. Melemenis and collaborators of the **IAA** recovering the skeleton of an elasmosaurid in the Cretaceous of the López de Bertodano Formation, 1982.

TABLE 3 – Participants / collectors of the IAA-MLP Antarctic vertebrate paleontology project

Name	Institution	Country	CAVs
María Alejandra Abello	MLP-CONICET	La Plata, Argentina	IAAGeomarambio; IAA Paleovertebrados
Carolina Acosta Hospitaleche	MLP-CONICET	La Plata, Argentina	IAA Geomarambio; IAA Paleovertebrados
Cecilia Besendjak	IAA	CABA, Argentina	IAA Geomarambio
Leonel Acosta Burlaille	MLP	La Plata, Argentina	IAA Paleovertebrados
José María Ageitos	IAA-MLP	La Plata, Argentina	IAA Paleovertebrados
Pablo Amoedo	IAA-UBA	CABA, Argentina	IAA Geomarambio
Eugenia Arnaudo	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Nicolás Bauzá	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Cecilia Besendjak	IAA	CABA, Argentina	IAA Geomarambio
Mauricio Bigurrarena	MLP	La Plata, Argentina	IAA Paleovertebrados
Paula Bona	MLP-CONICET	La Plata, Argentina	IAA Geomarambio; IAA Paleovertebrados
Mónica Buono	CENPAT-CONICET	Puerto Madryn, Argentina	IAA Paleovertebrados
†Fernando Calabozo	IAA	CABA, Argentina	IAA Criología
Juan Canale	Museo de El Chocón-CONICET	Río Negro, Argentina	IAA Paleovertebrados
Ariana Paulina Carbajal	IMBIOMA	Río Negro, Argentina	IAA Paleovertebrados
Magalí Cárdenas	MACN-CONICET	CABA, Argentina	IAA Paleovertebrados
Bárbara Cariglino	MACN-CONICET	CABA, Argentina	IAA Paleovertebrados
Alfredo A. Carlini	MLP-CONICET	La Plata, Argentina	IAA Paleomarambio
Silvio Casadío	UN La Pampa-CONICET	La Pampa, Argentina	IAA Geomarambio
Ignacio Cerda	UNRN	Río Negro, Argentina	IAA Paleovertebrados
Laura Chornogubsky	MACN-CONICET	CABA, Argentina	IAA Paleovertebrados
Alberto L. Cione	MLP-CONICET	La Plata, Argentina	DNA-MLP agreement
Andrea Concheyro	IAA	CABA, Argentina	IAA Geomarambio, IAA Micropaleontología
Ornela E, Constantini	MLP	La Plata, Argentina	IAA Paleovertebrados
Rodolfo A. Coria	UNRN-CONICET	Río Negro, Argentina	IAA Paleovertebrados
Mario A. Cozzuol	MLP-CONICET	La Plata, Argentina	DNA-MLP agreement
Miguel Criscenti	MLP	La Plata, Argentina	IAA Paleomarambio
Martín de los Reyes	IAA	La Plata, Argentina	IAA Paleovertebrados
Federico Degrange	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Gerardo Fabris	MLP	La Plata, Argentina	GEOANTAR, DNA-MLP agreement
Marta S. Fernández	MLP-CONICET	La Plata, Argentina	IAA Geomarambio; IAA Paleovertebrados
Javier N. Gelfo	MLP-CONICET	La Plata, Argentina	IAA Geomarambio, IAA Paleovertebrados
Daniel García López	INSUGEO-CONICET	Tucumán, Argentina	IAA Paleovertebrados

TABLE 3 – Continuation

Name	Institution	Country	Plan Anual Antártico (CAVs)
Gabriel Giordanengo	UBA	CABA, Argentina	IAA Bioestratigrafia
Soledad Gouiric Cavalli	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Yanina Herrera	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Facundo Huidobro	IAA-UBA	CABA, Argentina	IAA Geomarambio
Ari Iglesias	IMBIOMA-CONICET	Río Negro, Argentina	IAA Paleovertebrados
Facundo Irazoqui	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Guillermo M. López	MLP	La Plata, Argentina	IAA Geomarambio; IAA Paleovertebrados
Jorge Lusky	IAA	CABA, Argentina	IAA Bioestratigrafía
Rolando Maidana	FAA	CABA, Argentina	IAA Geomarambio, Air Force logistic
Sergio A. Marenssi	IAA	CABA, Argentina	IAA Geomarambio
Daniel Martinioni	IAA	CABA, Argentina	ÍAA Bioestratigrafia
Gabriela Massaferro	UBA	CABA, Argentina	IAA Geomarambio
Víctor A. Melemenis	MLP	La Plata, Argentina	GEOANTAR, DNA-MLP agreement
Florencia Milanese	IAA-CONICET	CABA, Argentina	IAA Bioestratigrafía
†Omar J. Molina	MLP	La Plata, Argentina	GEOANTAR, DNA-MLP agreement 1974
Juan José Moly	MLP	La Plata, Argentina	IAA Geomarambio, IAA Paleomarambio, IAA Paleovertebrados
Alejandro Monti	IAA-UBA	CABA, Argentina	IAA Geomarambio
Nahuel Muñoz	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Francisco Mussel	IAA	CABA, Argentina	IAA Bioestratigrafia
Laura Net	IAA-UBA	CABA, Argentina	IAA Geomarambio
Laura Nicoli	MACN-CONICET	CABA, Argentina	IAA Paleovertebrados
†Oscar E. Odreman Rivas	MLP, Servicio Geológico y Minero	Venezuela	GEOANTAR, DNA-MLP agreement 1975
José P. O'Gorman	MLP-CONICET	La Plata, Argentina	IAA Geomarambio; IAA Paleovertebrados
Eduardo B. Olivero	CADIC-UNTdF-CONICET	Ushuaia, Argentina	IAA Bioestratigrafía
Alejandro Otero	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Leandro Pérez	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Fernanda Podestá	IAA	CABA, Argentina	IAA Paleovertebrados
Pablo Puerta	MPEF-CONICET	Chubut, Argentina	IAA Paleovertebrados
María Eugenia Raffi	CADIC-UNTdF	Ushuaia, Argentina	IAA Bioestratigrafia, IAA Paleovertebrados
Marcelo A. Reguero	IAA-MLP-CONICET	La Plata, Argentina	GEOANTAR, IAA Paleomarambio, IAA Geomarambio, IAA Paleovertebrados
Marco A. Ríos	IAA	CABA, Argentina	DNA-IAA logistic
Gervasio Robles	IAA-UBA	CABA, Argentina	IAA Geomarambio
Flavia Salani	UBA	CABA, Argentina	IAA Geomarambio

TABLE 3 – Continuation

Name	Institution	Country	Plan Anual Antártico (CAVs)
Leonardo Salgado	UNRN-CONICET	Río Negro, Argentina	IAA Paleovertebrados
Rodolfo Sánchez	IAA	CABA, Argentina	IAA Geomarambio
Sergio N. Santillana	IAA	CABA, Argentina	IAA Paleovertebrados
Alejandra Sosa	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Jorge Strelin	IAA	CABA, Argentina	IAA Criología
Marianella Talevi	UNRN-CONICET	Río Negro, Argentina	IAA Paleovertebrados
Claudia P. Tambussi	MLP-CONICET	La Plata, Argentina	IAA Geomarambio; IAA Paleovertebrados
Marcelo Tejedor	CENPAT-CONICET	Puerto Madryn, Argentina	International agreement IAA-NSF
David Tineo	CIG-CONICET	La Plata, Argentina	IAA Paleovertebrados
Eduardo P. Tonni	MLP-CIC	La Plata, Argentina	DNA-MLP agreement 1977
Carolina Vieytes	MLP-CONICET	La Plata, Argentina	IAA Paleovertebrados
Ana Vrba	UBA	CABA, Argentina	IAA Geomarambio
Sergio F. Vizcaíno	MLP-CONICET	La Plata, Argentina	IAA Paleomarambio, IAA Geomarambio
Virginia Villamayor	MLP	La Plata, Argentina	IAA Paleovertebrados
Foreign researchers			
Thomas Mörs	NRM	Sweden	International agreement IAA-NRM
Johan Hangström	NRM	Sweden	International agreement IAA-NRM
Miles Eccleston	Trent University	Canada	International agreement IAA
Michael O. Woodburne	UCR	USA	International agreement IAA-NSF
William J. Zinsmeister	Purdue University	USA	International agreement IAA-NSF
Judd Case	Eastern Washington University, Cheney	USA	International agreement IAA-NSF
James Martin	South Dakota School of Mines and Technology, Rapid City	USA	International agreement IAA-NSF
John Foster	SD Geological Survey, Rapid City	USA	International agreement IAA-NSF
Philip J. Currie	Royal Tyrrell Museum, Alberta	Canada	International agreement IAA-MLP
E.B.Koppelhus	Royal Tyrrell Museum, Alberta	Canada	International agreement IAA-MLP
Dan Chaney	National Museum of Natural History, Smithsonian Institution, Washington	USA	International agreement IAA-NSF
Andreij Gazdzicki	Academy of Sciences, Warzaw	Poland	International agreement IAA-Poland
Andreij Tatur	Academy of Sciences, Warzaw	Poland	International agreement IAA-Poland
Ross Macphee	AMNH, New York	USA	International agreement IAA-NSF
Ascanio Rincón	Venezuelan Institute for Scientific Research	Venezuela	International agreement IAA-Venezuela
Manuel Montes	Instituto Geológico y Minero de España (IGME), Madrid	Spain	International agreement IAA-IGME
Francisco Nozal	Instituto Geológico y Minero de España (IGME), Madrid	Spain	International agreement IAA-IGME
Fernanda Quaglio	Universidade Federal de São Paulo	Brazil	International agreement IAA-MLP

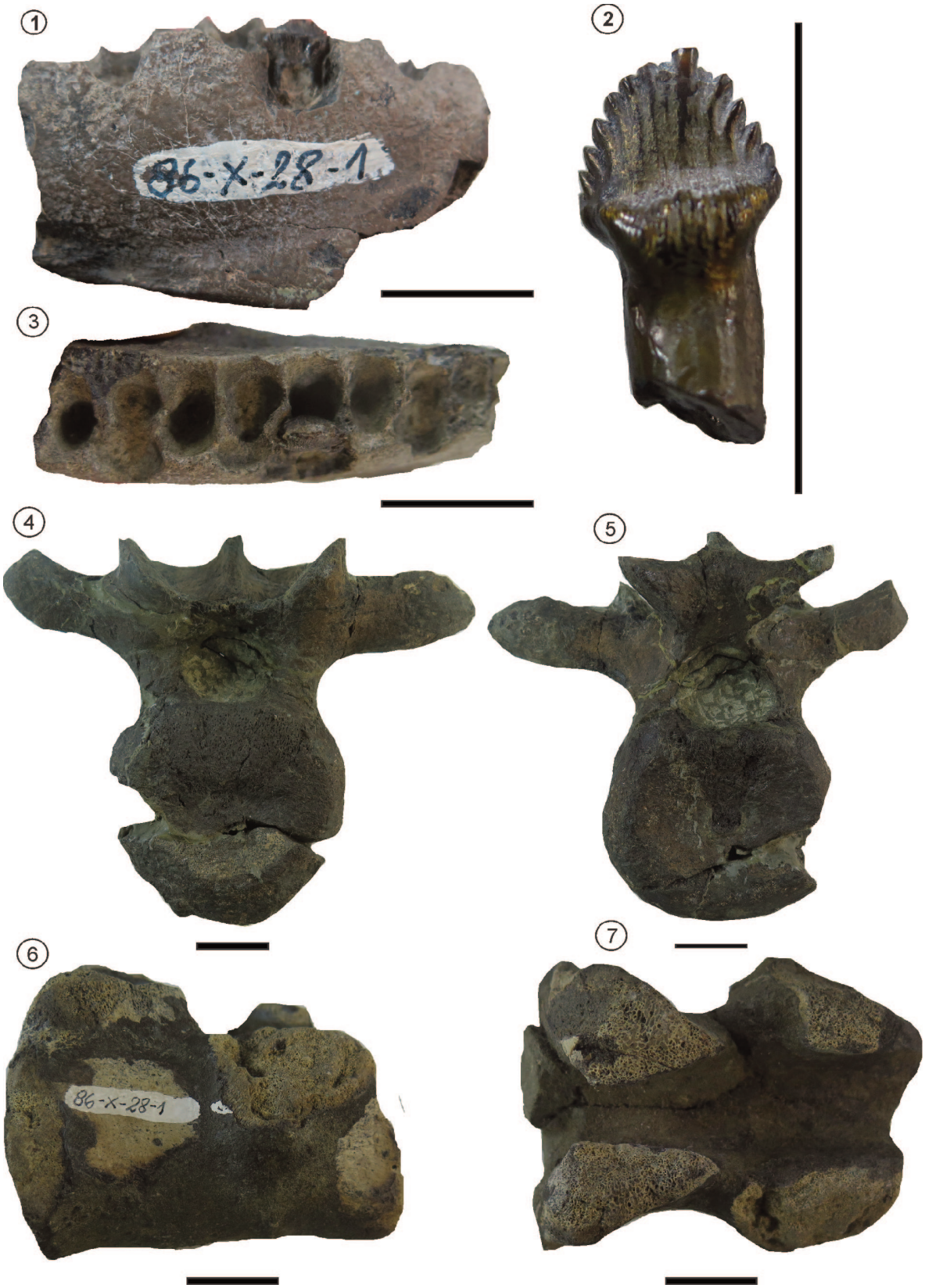

Figure 14. ***Antarctopelta oliveroi*** (holotype **MLP-PV 86-X-28-1**); **1, 3,** left dentary in **1,** medial and **3,** dorsal views; **2,** teeth in labial view; **4–5**, dorsal vertebra in **4,** anterior and **5,** dorsal views; **6–7,** dorsal vertebrae from the presacral; **6,** lateral and; **7,** dorsal views. Scale bar= 20 mm.

Figure 15. Commemorative stamp designed by Correo Argentino for the discoveries of fossil vertebrates in Antarctica; **1,** discovery of marine reptiles in Antarctica in 1992; **2,** discovery of ***Antarctopelta oliveroi*** in 1986.

The holotype (Fig. 14) is the only known specimen of this genus and species and was the first dinosaur ever found in Antarctica (Fig. 15). The excavation was completed over several field seasons (1987, 1988, and 2011) due to the frozen ground and harsh weather conditions. Much of the skeleton is in poor condition, as many of the bones nearest to the surface were subjected to years of fragmentation and weathering. *Antarctopelta oliveroi* was not named until 2006 (Salgado & Gasparini, 2006).

Six CAV were carried out during this period: 1983, 1984, 1986, 1987, 1988, and 1989. Eight collection transactions were recorded in the DPV Record Book of Fossil Vertebrates: MLP-PV 83-I-12-1, MLP-PV 83-V-20-1, MLP-PV 83-V-30-1, MLP-PV 84-II-1-1, MLP-PV 86-V-30-1, MLP-PV 87-II-1-1, MLP-PV 88-I-1-1, and MLP-PV 89-III-2-1. The number of specimens collected in this period and housed in the MLP is estimated at 3,100 specimens. Participants /collectors of the IAA-MLP are listed in Table 3.

Period DNA-MLP agreement – IAA Geomarambio 1990–2009

1990 was the year of the beginning of the fieldworks in camps of the DNA-IAA in Antarctica. All the vertebrate paleontologists from the MLP participated in the IAA Geomarambio group during this period (Fig. 16.1–16.2, Table 3)

In 1991 and 1992, two fieldworks in the Paleogene of Marambio (Seymour) Island were carried out by an international agreement between IAA and the Academy of Science of Warsaw, Poland (Fig. 16.3, Tab. 3).

In 1993, the extraction of the skeleton of the elasmosaurid *Vegasaurus molyi* (Fig. 17) in Cape Lamb, Vega Island started. The excavation was completed over several field seasons (1998, 2005) due to the frozen ground and harsh weather conditions.

In 1998, 2001, and 2005, three fieldworks in the Paleogene of Seymour/Marambio and Cretaceous of Cape Lamb, Vega islands were carried out together with US researchers (an international agreement between IAA and the NSF, USA (Fig. 17.4, Tab. 3).

In 2006 and 2007, two fieldworks in the Paleogene and Cretaceous of Marambio (Seymour) Island were carried out together with Spanish researchers (an international agreement between IAA and the Instituto Geológico y Minero de España, Spain) (Montes *et al.*, 2013) (Fig. 17.5, Tab. 3).

During the 2007 CAV, a wonderful specimen of a flying bird was recovered from sediments of the early Paleocene belonging to the López de Bertodano Formation at Marambio (Seymour) Island. The skeleton of *Conflicto antarcticus* was described as an anseriform by Tambussi *et al.* (2019) (Fig. 18).

During the 2008 CAV, an incomplete and semi articulated specimen of an ornithopod dinosaur, *Trinisaura santamartaensis* (Coria *et al.*, 2013), was collected by Juan José Moly and Rodolfo A. Coria (Tab. 3) from deposits of the Snow Hill Island Formation in Santa Marta Cove, James Ross Island (Fig. 19).

In the summer of 2008, fieldwork in the Cretaceous of

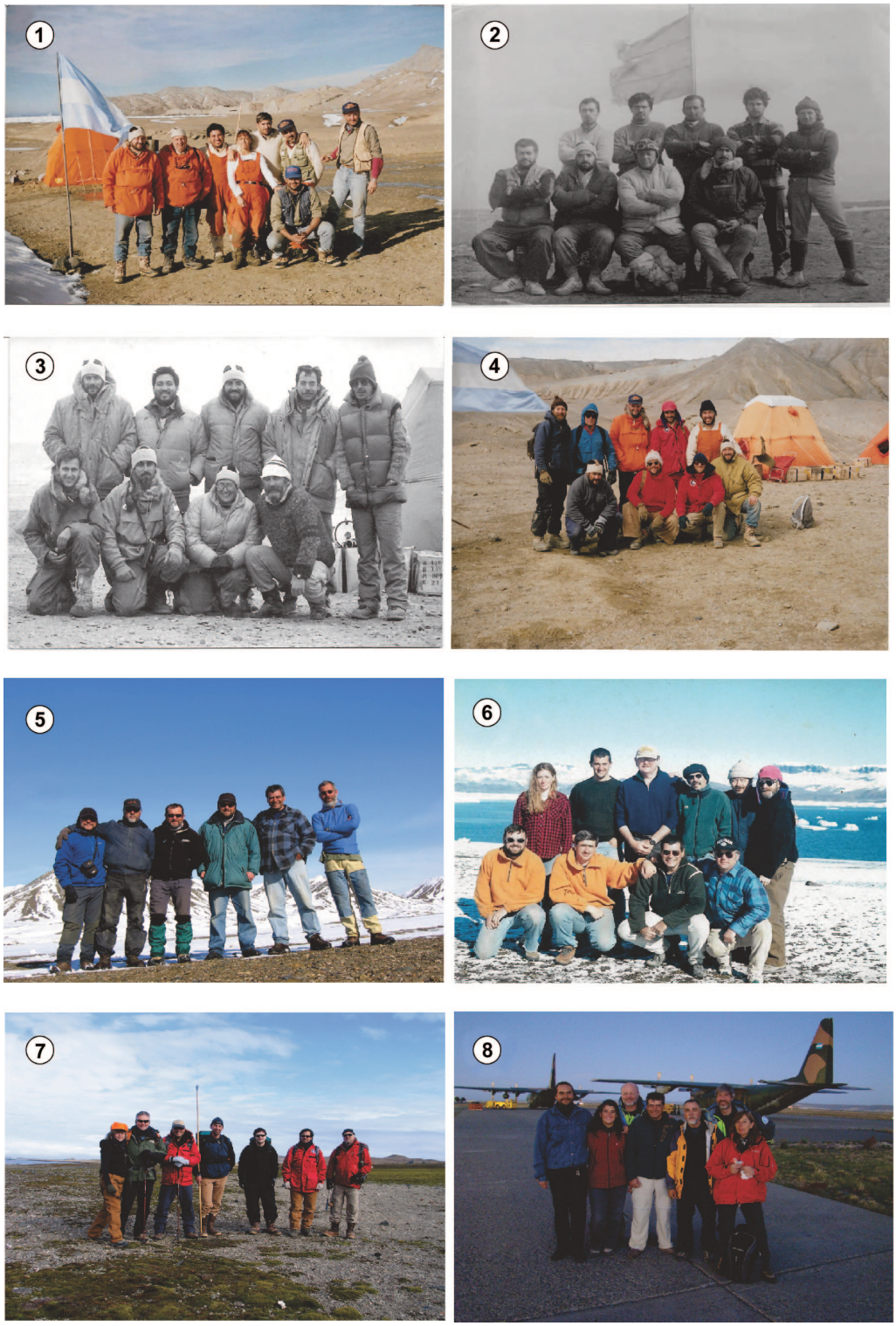

Figure 16. Period **IAA GEOANTAR** Program 1974–1982, Period **DNA-MLP** agreement – **IAA** Paleomarambio 1983–1989 and Period **DNA-MLP** agreement – **IAA** Geomarambio 1990–2009: **1–2,** teams of Geomarambio, Paleogene of Marambio (Seymour) Island; **1,** 1989; **2,** 1990; **3,** team international agreement **IAA**-Poland, Paleogene of Marambio (Seymour) Island, 1992; **4,** team international agreement **IAA-NSF** (USA), Paleogene of Marambio (Seymour) Island, 1991; **5,** team international agreement **IAA-IGME** (Spain), Paleogene of Marambio (Seymour) Island, 2006; **6,** team international agreement **IAA-NSF** (USA), Cretaceous of Cape Lamb (Vega Island), 1991; **7,** team international agreement **IAA-NSF** (USA), Cretaceous of Byers Peninsula (Livingston Island), 2008; **8,** team international agreement **IAA-NRM** (Sweden), Paleogene of Marambio (Seymour) Island, 2009.

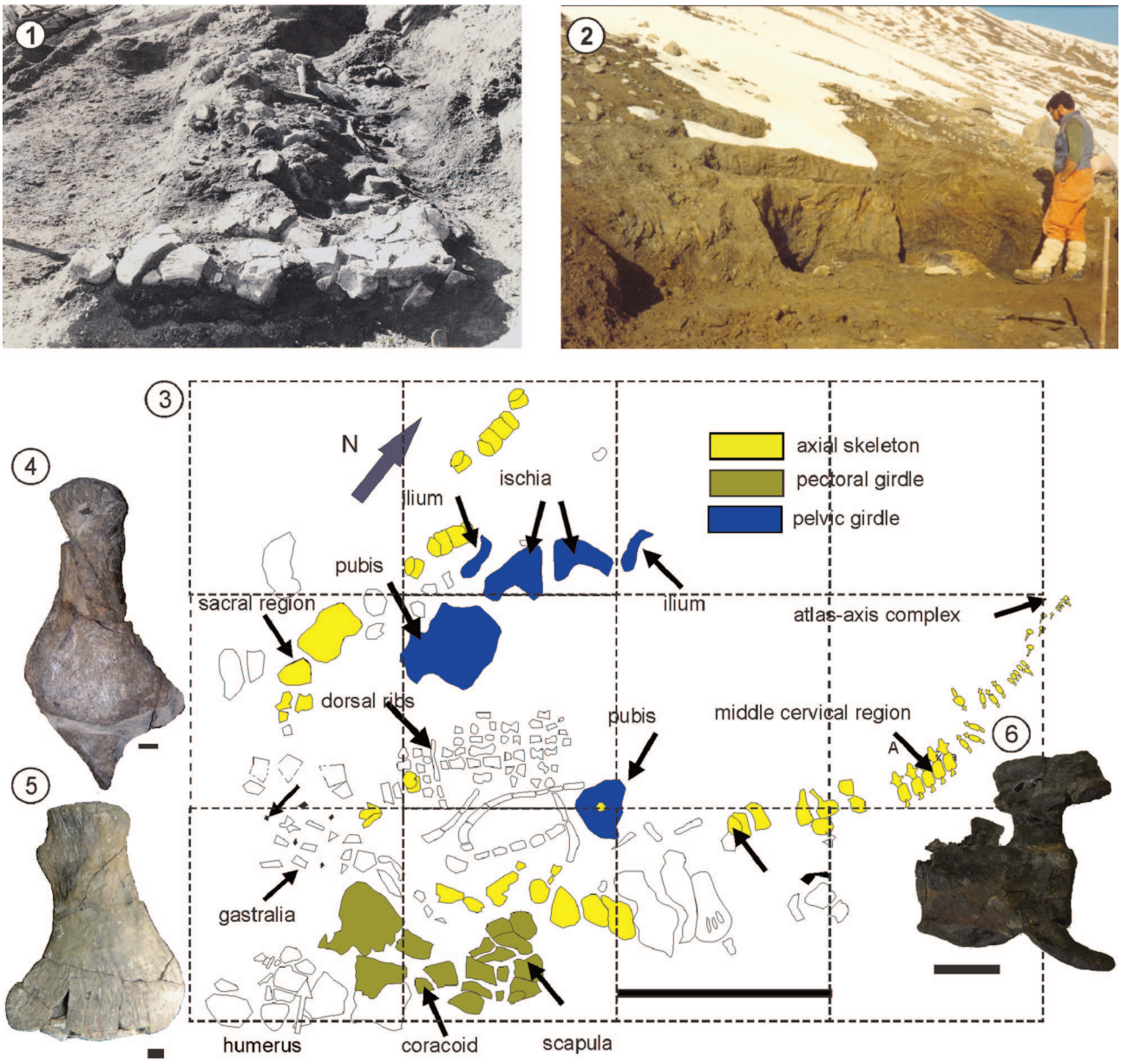

Figure 17. ***Vegasaurus molyi*** (holotype **MLP-PV 93-I-5-1**). **1–2,** quarry. 1, early quarry stage of work (1989) and 2, a more advanced stage of quarry process (1993); **3,** quarry diagram. The side lengths of the squares equal 50 cm; **4,** right femur in ventral view; **5,** left humerus in ventral view; **6,** atlas-axis complex in left lateral view. Scale bar= 20 mm (4, 5, 6).

the Livingston Island was carried out together with US researchers (an international agreement between IAA and the NSF) (Fig. 16.7, Tab. 3).

Eighteen CAVs were done during this period: 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1998, 2000, 2001, 2002, 2004, 2005, 2006, 2007, 2008, 2009, and one PreCAV: 1996. Twenty three collection transactions were recorded in the DPV Record Book of Fossil Vertebrates: MLP-PV 90-I-20-1, MLP-PV 91-II-4-1, MLP-PV 91-II-5-1, MLP-PV 92-II-2-1, MLP-PV 93-I-3-1, MLP-PV 93-X-1-1, MLP-PV 94-III-15-1, MLP-PV 95-I-10-1, MLP-PV 96-I-5-1, MLP-PV 98-I-X-1, MLP-PV 99-XII-1-1, MLP-PV 00-I-1-1, MLP-PV 00-I-5-1, MLP-PV 00-I-10-1, MLP-PV 01-I-1, MLP-PV 02-XII-20-1, MLP-PV 04-III-1-1, MLP-PV 04-III-2-1, MLP-PV 04-III-3-1, MLP-PV 05-I-1-1, MLP-PV 07-III-1-1, MLP-PV 07-III-2-1, and MLP-PV 08-XI-30-1.

Figure 18. ***Conflicto antarcticus*** (holotype **MLP-PV 07-III-1-1**); **1,** quadrate; **2,** skull; **3,** right humerus in caudal view; **4,** left humerus in cranial view; **5,** furcula in cranial view; **6,** sternum; **7,** left tibiotarsus in cranial view; **8,** coracoid in ventral view; **9,** left radius; **10,** syrinx; **11,** left carpometacarpus in medial view; **12,** right carpometacarpus in medial view; **13,** postcranial remains; **14,** right phalanx *proximalis digitimajoris* in medial view; **15–22,** vertebrae.

Figure 19. ***Trinisaura santamartaensis*** (holotype **MLP-PV 08-III-1-1**); **1,** pubis in left lateral view; **2,** ischium in left lateral view; **3,** caudal vertebrae in left lateral view; **4,** left femur in left lateral view; **5,** diagram showing the illustrated elements of pelvis. Scale bar= 50 mm.

The number of specimens collected in this period and housed in the MLP is estimated at 14,500 specimens. Participants/collectors of the IAA-MLP of the IAA-MLP are listed in Table 3.

Period Plan Anual Antártico DNA – IAA Paleovertebrados 2010–2015

Since 2010, the vertebrate paleontological investigations of the IAA-MLP were included in the PAA of the DNA-IAA (Ministerio de Relaciones Exteriores, Comercio Internacional y Culto) (IAA Paleovertebrados).

Three fieldworks (2012, 2013, and 2014) in the Paleogene of Marambio (Seymour) Island and Cretaceous of the Vega Island were carried out together with Swedish researchers (international agreement between IAA and the NRM, Sweden) (Fig. 16.8; Tab. 3).

Finally, six CAVs were done by the IAA Paleovertebrados teams during this period (Fig. 20): 2010, 2011, 2012, 2013, 2014, and 2015; and as a result, twelve collection transactions were recorded in the DPV Record Book of Fossil Vertebrates: MLP-PV 10-XII-1-1, MLP-PV 11-II-20-1, MLP-PV 11-II-21-1, MLP-PV 12-II-10-1, MLP-PV 12-I-20-1, MLP-PV 13-I-25-1, MLP-PV 13-I-26-1, MLP-PV 14-I-10-1, MLP-PV 14-I-20-1, MLP-PV 15-I-7-1, MLP-PV 15-I-10-1, and MLP-PV 15-I-12-1. The number of specimens collected in this period and housed in the MLP is estimated at 12,200 specimens. Participants/collectors of the IAA-MLP are listed in Table 3.

After that, the Antarctic Repository of Paleontological and Geological Collections of the IAA was created through

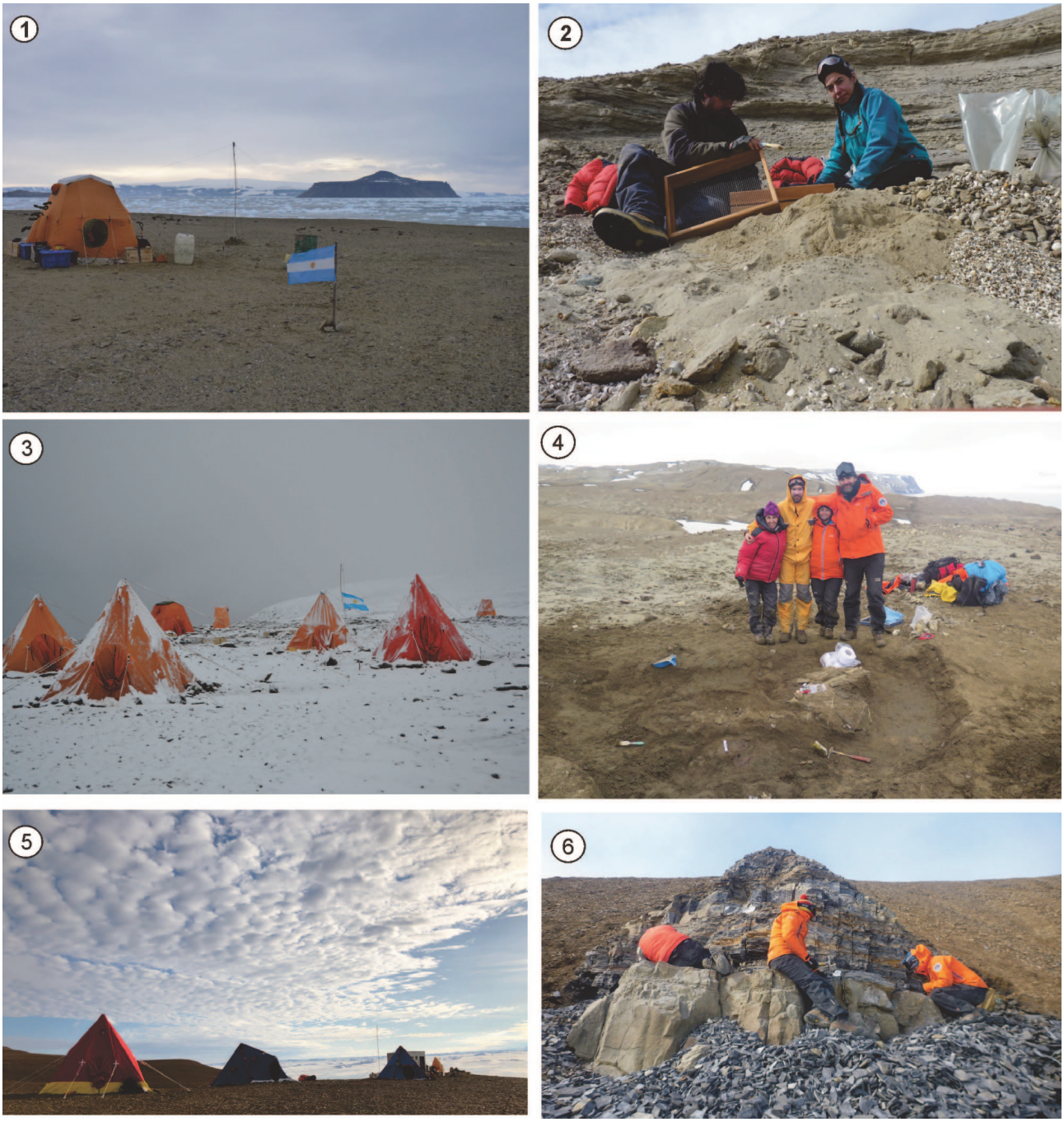

Figura 20. Period **PAA DNA–IAA** Paleovertebrados 2010–2015; **1–2,** *Paleovertebrados Paleógeno*, camp and team Paleogene of Marambio (Seymour) Island, 2012; **3–4,** *Paleovertebrados Cretácico*, camp and team Cretaceous, 3, Cape Lamb, Vega Island, 2015, and 4, Marambio (Seymour) Island, 2018; **5–6,** *Paleovertebrados Jurásico*, camp and team Jurassic of Cape Longing, Antarctic Peninsula, 2020.

DNA provision No. 9 "T"/15 in October 1st, 2015. Since then, all paleontological remains and geological samples (fossils and rocks) collected on the Antarctic continent during the development of scientific activities organized by the IAA (DNA-MRECIC) are deposited there in compliance with the provisions of the PAA. It means that, within the framework of the same work project, the Paleovertebrados groups working in Antarctica continue collecting fossil vertebrates but they are deposited in the IAA repository since the CAV 2016.

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